DESIGN AND CONSTRUCTION OF MILITARY BUILDINGS.

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DESIGN AND CONSTRUCTION

OF

MILITARY BUILDINGS.

A

HANDBOOK

FOR THE USE OF ROYAL ENGINEER OFFICERS AND THEIR STAFF.

SECTION I.—General Remarks.
SECTION II.—Details of Construction.
SECTION III.—Outline Specifications.

COMPILED IN THE OFFICE OF THE DIRECTOR OF FORTIFICATIONS AND WORKS.

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Section I.

GENERAL REMARKS.

Arrangement of Buildings on Sites.

Arrangement of Buildings.—Buildings should not be so scattered as to waste sites and unduly increase either the cost of the construction and maintenance of Roads, Drainage, Gas and Water Services, &c., or the labour of the Troops in keeping Roads and Parades in order; but the Barrack, as a whole, and the different portions of it (*e.g.*, for Officers, Single Men, Married Men, &c.) and even the several buildings, as far as practicable, should be so designed and arranged as to render extension possible, to meet varying requirements and changes of establishment. Latrines, Cook Houses, &c., should be as far as possible to leeward as regards prevailing winds.

Intervals between Buildings.—The distances between parallel rows of buildings intended for habitation should not be less than twice the height of the loftier of the two adjacent buildings from the ground floor to the eaves, and the ends of the spaces between the rows should be kept open to ensure proper circulation of air.

Aspect.—At Home Stations, in order to obtain uniform exposure to sunlight, long blocks intended for habitation should, whenever possible, have their lengths running North and South; this is especially important when there are several parallel blocks. Larders, Milk Stores, Kitchens and Draughtsmen's Offices should face North or, failing that, East. The best aspect for Living Rooms is from S.E. to S.W., but the advantage of a good view from the windows must not be lost sight of.

At Stations in lower latitudes, where there is too much, rather than too little, sunlight, the direction of prevailing winds is usually the chief factor in determining the aspect.

When buildings are in exposed positions, care should be taken, if possible, to place the entrance doors on the most sheltered side of the building. It may be occasionally necessary to protect the entrance by a porch with an opening at the side.

Formation of Sites.—In the formation of sites care should be taken never to reduce them to a dead level, but to leave or make sufficient fall for the surfaces to shed water readily, and for the gutters to act without excessive deepening.

When possible the excavation and filling should about balance. Terracing can often be resorted to with advantage in order to avoid steep falls. The embankments should allow for settlement.

The natural soil should be removed from the actual sites of the buildings, and the portions beneath the floors should subsequently be sealed with a layer of cement concrete.

Subsoil Drainage.—It is very important, from a sanitary point of view, that the level of the subsoil water should be some distance below the surface of the ground.

Treatment of Old Sites.—When a new building, intended for habitation, is to be erected on the site of an old building, the surface earth, over the whole site of the new building, should be dug up for a depth of about 12 in. and removed, the portions beneath the floors being subsequently sealed as directed above.

Design of Buildings, Hints on.

Design of Buildings.—

1. The fundamental principles are:—

(a) The building shall be suited in every respect to its purpose; having regard both to the internal occupation and to the local and climatic conditions.
(b) There shall be the maximum economy compatible with other conditions.
(c) The outward appearance shall afford indication (at any rate to the trained eye) of the character of the internal arrangement and purpose. In other words, the Elevation should not be a thing apart, but the natural outcome of the Plan.
(d) The ornamentation shall be in keeping with the general style of the building, applied so as to enrich and emphasise the constructional features, and so designed as to produce the maximum effect at the minimum cost, having regard to its distance from the eye of the observer. Ornamentation should, however, always be subordinate in character, the architectural effect of a building depending mainly on the grouping and balance of its various parts and the choice of suitable materials.

2. It is clear that to comply with (a) the first thing to do is to ascertain fully and exactly the purpose of the proposed building and of each and every portion of it; that is to say, to find out the numbers and descriptions of the persons, horses, stores, fittings, furniture, &c., &c., to be provided for; the organisation of the personnel, and the general nature, at least, of the various functions they are to perform in the building; the sub-division and method of arranging the stores; the personal habits, wants and preferences of the occupants, &c., &c., &c.

The more carefully this investigation is made the greater is the probability of a really convenient building being designed. Not only, therefore, should the local Officers concerned be invariably consulted, but the designer should endeavour to make himself master of their real needs.

3. A decision can now be arrived at as to the number of rooms required and the Floor and Cubic Space in each; and generally as to their proper relative positions with regard to each other, to the Entrances, &c., &c.

4. Before, however, starting on a sketch plan the site must be considered. If not already fixed upon, it should be chosen after careful study of the ground, or—if that be impossible—of a plan which, to be suitable to the purpose, should be contoured at not less than 5 ft. vertical intervals (the actual site itself

Design of Buildings, Hints on—*continued.*

better at 2 ft. intervals), and should show the position, approximate height, materials of which built, and occupation of all surrounding buildings, all Roads and lines of Drainage, Gas or Electric Mains and Water Supply, the points of the compass, and the best prospects afforded. Upon the site area available the number of stories in the building will often depend.

5. The special local and climatic conditions must now be considered, *e.g.*, whether the buildings must be raised above the ground, whether verandahs are necessary, what system of sewage disposal is to be adopted, whether skilled labour is available, and whether there are any special local building practices.

6. In connection with this the materials to be used must be decided upon, bearing in mind cost and facility of supply, importance and purpose of the building, character of climate, exposure of site, &c., &c.

7. The designer is now in a position to get out a Preliminary Sketch Plan (scale say $\frac{1}{16}$ in.) of each floor—starting with the most important—in which the various rooms can be given their proper aspect as regards neighbouring buildings, point of compass, and prevailing winds and prospect; in which the important matter of Drainage, Warming, Lighting and Water Supply can receive due attention, and in which any irregularities, &c., of the site can be turned to the best advantage. At this stage also the possibility of future extension should be considered and, as far as may be, provided for.

8. In preparing this sketch plan care should be taken to avoid anything that may lead to useless expense, *e.g.* :—

i. Long passages should be avoided (it has been said that the excellence, or at any rate the economy, of a plan is inversely as its passage area); in connection with this the position of staircases should be considered.

ii. Fireplaces and outlet ventilators should be so placed as to admit of the flues being easily grouped into a small number of stacks.

iii. Internal constructional walls on upper floors should, as far as possible, be arranged so as to come immediately over those on the lower floors.

iv. The roofs should be simple and without excessive spans. This is a very important point, and may often lead to some little modifications of the plan—generally, however, in the direction of greater simplicity.

9. Rough sections should now be made to enable the building to be cubed out, and an approximat idea of the cost arrived at. If this is unsatisfactory, some modification of the plan may be necessary.

10. The number and size of the windows for each room, &c., should now be settled, so as to give the proper glass space, and the position of the same fixed so as to give the best aspect and view, to throw the light in the right places, and to admit of a convenient arrangement of the furniture, &c. The position of roof trusses must be considered also in the case of the top floor.

11. Now—and not till now—should the Elevations be sketched out. They may be found to render some further alterations to the plan desirable, but it must always be borne in mind that the internal convenience must not be sacrificed to any striving after external symmetry or effect.

12. In the case of an important building, a Perspective Sketch should next be prepared. This, besides giving an idea of the general effect, will show where any ornamentation can be most effectively introduced. In W.D. buildings, however, there is usually little or no money to spare for ornamentation.

13. To enable the preliminary sketches to be properly considered, they should always be supplemented and accompanied by an approximate estimate and a brief skeleton specification.

14. When the preliminary sketches have been approved the $\frac{1}{4}$th scale drawings may be commenced, the plan of the most important floor being set out first. At this stage it becomes necessary to go thoroughly into details, and with care and forethought much may be done not only to increase the convenience of the building, but also to save trouble and expense in construction. For instance, in a brick building the size of the bricks to be used should always be borne in mind, and the breadth of narrow panels, piers and pilasters should conform to brick or half-brick dimensions. Again, trade scantlings should always be adopted in preference to special sizes, particularly in ironwork. The joinery work also should, as far as possible, be so designed that one pattern may serve for a number of articles, *e.g.*, windows should be identical unless there is good reason to vary them, &c., &c.

Drainage.

See Drainage Manual.

Electric Lighting.

The number of lamps will be determined by calculation of the candle-power required with reference to the floor space to be lighted (see Table in Barrack Synopsis, Part I). The ordinary stock sizes of the lamps, viz., 8, 16, 25, 32 candle-power, &c., may be counted as the effective candle-power. For economy in wiring it is desirable to reduce the number of lighting points as far as is compatible with proper diffusion of the light.

Gas Supply.

*TABLE showing the consumption per hour of ordinary Bray's Union Jet Burners under varying pressures, together with the Candle Power per cub. ft. and the total Candle Power of the flame, using London 16-Candle Power Gas. The readings were taken on a Wright's 60-in. Bar Photometer fitted with a Methven 2-Candle Screen, and the figures below are the average of four series of tests :—

No. of Burner.	Pressure	4/10	5/10	6/10	7/10	8/10	9/10	10/10	11/10	12/10	13/10	14/10	15/10	16/10	17/10	18/10	19/10	20/10
1	Consumption	1·80	2·05	2·30	2·55	2·775	3·00	3·20	3·40	3·60	3·80	4·00	4·175	4·35	4·50	4·65	4·80	4·95
	Candle Power per cub. ft.	*1·00*	*·951*	*·913*	*·862*	*·820*	*·783*	*·746*	*·713*	*·680*	*·651*	*·625*	*·599*	*·574*	*·555*	*·537*	*·521*	*·505*
	Total Candle Power ...	1·80	1·95	2·10	2·20	2·275	2·35	2·387	2·425	2·45	2·475	2·50	2·50	2·50	2·50	2·50	2·50	2·50
2	Consumption	2·10	2·50	2·80	3·10	3·35	3·60	3·85	4·10	4·30	4·50	4·70	4·90	5·10	5·275	5·45	5·625	5·80
	Candle Power per cub. ft.	*1·285*	*1·230*	*1·178*	*1·145*	*1·119*	*1·090*	*1·065*	*1·036*	*1·012*	*·977*	*·947*	*·918*	*·882*	*·853*	*·821*	*·786*	*·741*
	Total Candle Power ...	2·70	3·05	3·30	3·55	3·75	3·925	4·10	4·25	4·35	4·40	4·45	4·50	4·50	4·50	4·475	4·425	4·30
3	Consumption	2·80	3·25	3·65	4·00	4·325	4·65	4·95	5·25	5·55	5·825	6·10	6·35	6·60	6·85	7·075	7·30	7·50
	Candle Power per cub. ft.	*1·643*	*1·631*	*1·616*	*1·600*	*1·572*	*1·527*	*1·475*	*1·414*	*1·361*	*1·287*	*1·230*	*1·173*	*1·121*	*1·073*	*1·024*	*·979*	*·933*
	Total Candle Power ...	4·60	5·30	5·90	6·40	6·80	7·10	7·30	7·425	7·50	7·50	7·50	7·45	7·40	7·35	7·25	7·15	7·00
4	Consumption	3·25	3·75	4·25	4·70	5·10	5·475	5·85	6·20	6·55	6·875	7·175	7·45	7·725	7·975	8·225	8·45	8·65
	Candle Power per cub. ft.	*1·723*	*1·700*	*1·670*	*1·638*	*1·593*	*1·539*	*1·479*	*1·420*	*1·358*	*1·294*	*1·233*	*1·174*	*1·113*	*1·053*	*·984*	*·911*	*·853*
	Total Candle Power ...	5·60	6·375	7·10	7·70	8·125	8·425	8·65	8·80	8·90	8·90	8·85	8·75	8·60	8·40	8·10	7·70	7·20
5	Consumption	3·50	4·00	4·50	5·00	5·45	5·85	6·20	6·55	6·85	7·15	7·45	7·70	7·925	8·175	8·40	8·625	8·85
	Candle Power per cubic ft.	*1·930*	*1·925*	*1·911*	*1·875*	*1·862*	*1·837*	*1·806*	*1·711*	*1·722*	*1·650*	*1·571*	*1·487*	*1·400*	*1·303*	*1·197*	*1·095*	*4·99*
	Total Candle Power ...	6·75	7·70	8·60	9·375	10·15	10·75	11·20	11·60	11·80	11·80	11·70	11·45	11·10	10·64	10·05	9·45	8·80
6	Consumption	4·00	4·65	5·25	5·80	6·30	6·80	7·25	7·70	8·125	8·55	8·95	9·325	9·70	10·05	10·40	10·75	11·10
	Candle Power per cub. ft.	*2·500*	*2·527*	*2·543*	*2·543*	*2·540*	*2·537*	*2·524*	*2·500*	*2·481*	*2·409*	*2·335*	*2·177*	*1·881*	*1·666*	*1·514*	*1·418*	*1·351*
	Total Candle Power ...	10·00	11·75	13·35	14·75	16·00	17·25	18·30	19·25	20·00	20·60	20·90	20·30	18·25	16·75	15·75	15·25	15·00
7	Consumption	4·60	5·30	5·95	6·55	7·15	7·725	8·275	8·80	9·275	9·725	10·15	10·55	10·95	11·35	11·75	12·125	12·50
	Candle Power per cub. ft.	*2·674*	*2·736*	*2·773*	*2·786*	*2·776*	*2·761*	*2·658*	*2·628*	*2·345*	*2·108*	*1·931*	*1·782*	*1·630*	*1·612*	*1·545*	*1·488*	*1·440*
	Total Candle Power ...	12·30	14·50	16·50	18·25	19·85	21·25	22·00	22·25	21·75	20·50	19.50	18·80	18·50	18·30	18·15	18·05	18·00
8	Consumption	4·80	5·60	6·35	7·05	7·70	8·30	8·90	9·45	9·95	10·45	10·90	11·35	11·80	12·25	12·70	13·10	13·50
	Candle Power per cub. ft.	*3·021*	*3·125*	*3·160*	*3·156*	*3·117*	*3·012*	*2·885*	*2·645*	*2·412*	*2·177*	*1·972*	*1·806*	*1·674*	*1·571*	*1·484*	*1·423*	*1·370*
	Total Candle Power ...	14·50	17·50	20·00	22·25	24·00	25·00	25·50	25·00	24·00	22.75	21·50	20·50	19·75	19·25	18·85	18·65	18·50

* NOTE.—It will be observed that, with a pressure of from 0·6 to 0·7, burners Nos. 6, 7, and 8 give the most economical results, while the smaller burners give the best result with a pressure of 0·4. The larger burners generally give better results than the smaller ones, and, as by far the greatest use of gas is for large burners, pressure should be regulated so as to secure the best results in their use.

With the object of reducing the pressure at the jet and thus effecting both a saving in consumption of gas and an improvement in the light, patent cap burners have in some cases been used with advantage in connection with the ordinary burners.

Gas Su
continue

The sizes of incandescent burners commonly in use are as follows :—

Normal Candle-power.	Effective Candle-power taken.	Approximate Gas Consumption, in feet per hour.	Description of Burner.
20	15	1	Inverted burner, bijou size.
30	22	1½	No. 1 Welsbach Kern. No. 2 Sugg's Diamond.
50	37	2½	No. 2 Kern. No. 3 Diamond.
60	45	3	Inverted burner, large size.
75	56	3½	No. 3 Kern. No. 3 Diamond.

It will always be desirable to have at least two burners in every large room, so that the room will not be plunged in darkness by the sudden failure of a mantle at a time when it may not be possible to replace it at once.

The Welsbach Kern or Sugg's Diamond burners are recommended for general use.

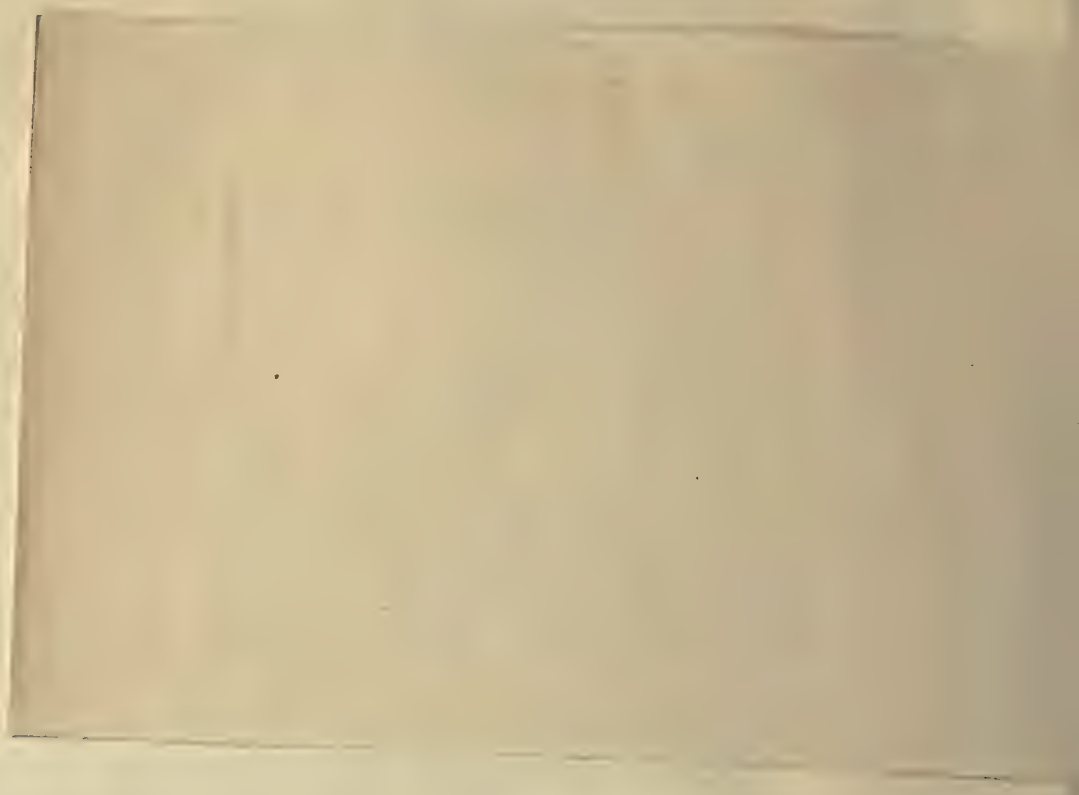
For Officers' Messes, Officers' Sitting Rooms, Serjeants' Messes and other situations where good appearance is a consideration and careful treatment may be expected, the inverted incandescent burners may be preferred.

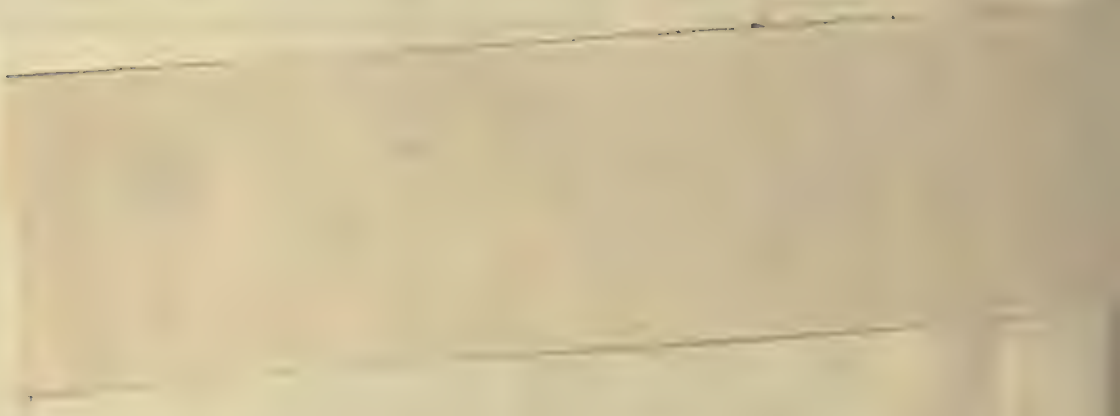
Each burner should be fitted with its own controlling tap on the fitting. In addition, a bye-pass on the burner is useful in certain cases, such as for billiard table lights, or for Officers' and N.C.O.'s rooms, where it may be convenient to be able to economise gas by turning it off when not immediately required, leaving the burner alight and ready to be turned up again at once when wanted.

In Barrack Rooms, Canteen Rooms, &c., a small rat-tail burner should be fitted, in addition to the incandescent burners, to serve as a pipe-lighter. Bray's burners, No. 0 and No. 1 sizes, with economizer caps, will be fitted in Passages, Ablution Rooms, &c.

Although it is necessary in work of an extensive nature to calculate the requisite sizes of pipes, taking into account all the variable factors, it may be convenient, in work of a minor character and under ordinary conditions, to use the following rough table :—

To supply	10	c. ft. requires a	⅜-in. pipe
,,	20	,,	½-in. ,,
,,	50	,,	¾-in. ,,
,,	120	,,	1-in. ,,
,,	250	,,	1¼-in. ,,
,,	450	,,	1½-in. ,,
,,	800	,,	2-in. ,,
,,	1,600	,,	3-in. ,,
,,	3,200	,,	4-in. ,,





Gas Supply— *continued.*

Brackets and Pendants.—Pendants should be at least 6 ft. 6 in. clear of the floor, and brackets at least 5 ft. clear. In passages they should be 6 ft. 6 in. clear of the floor or landing.

Burners.—The size and number of burners will be determined by calculation of the required candle-power with reference to the floor space to be lighted (see Table in Barrack Synopsis, Part I., where it is also laid down in which rooms incandescent burners are to be fitted). In selecting the size of incandescent burners required, 25 per cent. may usually be deducted from the candle-power advertised in manufacturers' catalogues. For the candle-power of Bray's burners the table above may be used.

Governors.—A governor will frequently be required on the outlet pipe of the main meter to keep the pressure down to that necessary to afford a steady light. Where Bray's Burners are in use a pressure of about 1 in. would be suitable at the main meter on a fairly level site in cases where there are no subsidiary meters; but these each absorb about $\frac{3}{10}$ in., so that the pressure on entering a Barrack will often have to be as much as 1½ in., or even more. If the mains fall much from the meter, the main governor should be adjusted to a higher pressure, while if the mains rise much, a somewhat lower pressure would suffice. Additional governors may become necessary on the principal branches and on the upper floors of buildings, to rectify the increase of pressure due to the rise (0·84 in. to every 100 ft. of rise), so as to secure a uniform pressure at the burners. With incandescent burners a higher pressure is desirable.

Governors should be under lock and key.

The governor at the main meter should be fixed on the Barrack side of the meter.

Meters.—All the gas supplied to a Barrack should pass through a main meter, and means should be provided for cutting it off entirely at one spot. All meters should be kept in secure places under lock and key, and the main meter key should be different from that of the other meters. A separate meter, either to check consumption or to ascertain the amount not chargeable to the public, should be fixed where necessary.

Meters are to be of a make approved by the Company supplying the gas, and stamped as tested under the "Sale of Gas" Acts.

Pipes, General Instructions.—All underground pipes should be of cast-iron, except branch pipes running under paved surfaces or those supplying a very small number of lights, which may be of wrought-iron of not less diameter than 1 in.

Pipes above ground should be of wrought-iron.

The mains should be laid at a sufficient depth below the surface to avoid risk of breakage from traffic, 18 in. may be accepted as the minimum depth; 4-in. mains should be laid with a fall of not less than 1 in 200 towards the syphons; larger mains may be given less fall.

Pipes running under concrete and asphalte paving should be laid inside drain pipes, and put together with connecting screws to allow of their being removed without disturbing the paving.

Pipes within buildings where the walls are unplastered should be fixed in the angles as far as possible. Where the walls are plastered they should be carried in chases, or run above the ceilings, the floor boards above them being fixed with screws. Service pipes should never be laid horizontal, but should have a fall towards the main.

Before fixing, pipes below ground should be well coated with coal tar, and those above ground should be twice painted with red lead or silicate oxide or iron oxide paint, and finished as may be directed.

All pipes should, after fixing, be charged with gas under pressure, and tested for leakage by passing a light all round the joints, and by smelling. In works of any magnitude, as a further test, the meter should be read when the gas is first turned on and again after some hours; care being taken that all taps are turned off during this time. Should any leak be thus shown to exist in the system, steps must be taken to localize it by closing valves at different points, or by making use of a test meter in different parts of the system.

Pipes, Cast-iron.—Cast-iron pipes of 1½-in. bore and upwards should have socket joints well caulked with tarred gaskin and run with lead.

In tapping cast-iron mains, the bore of the outlet bends should not be too large, in order to avoid weakening the main too much; for 2½-in. and 3-in. mains the maximum should be 1 in. and 1¼ in. respectively. Cast-iron mains under 2½-in. diameter should not be tapped for service pipes, but the connection should be made by means of a tee-piece or branch, into which the service pipe should be passed about 6 in., and the joint caulked and run with lead.

Pipes, Wrought-iron.—Wrought-iron pipes of 3-in. bore and under should be of strong wrought-iron, butt-welded tubing, with screwed socket joints, put together with red and white lead. When laid underground, they should be coated with two coats of coal tar.

Pipes, Sizes of.—The sizes of gas mains and service pipes may, in ordinary cases, be roughly calculated by the aid of tables, but it must be borne in mind that much will depend upon the nature of the gas supplied, the form of burners used, the available pressure at the entrance to the Barrack mains, and the lengths and rise and fall of the pipes supplying the different buildings and rooms. A liberal allowance should be made wherever there is a possibility of future extensions involving additional lights, and also for the contraction of the bore in course of time from corrosion and deposit.

Subject to such allowances, the size of the main, as it goes on, should be diminished in proportion to the number of lights supplied by pipes taken off it.

Service pipes should be reduced in size in a similar manner, according to the number of lights each has to supply in different parts of its course.

Pressure Gauges.—A pressure gauge of approved pattern should be fixed on both the inlet and outlet pipe of the main meter, and a portable gauge with burner attached should be provided for testing the pressure at different burners.

Stop-Cocks and Valves.—All service pipes leading to external lamps and buildings should have brass full-way screw-bottom stop-cocks, which in the latter case should be within the buildings, to allow of the gas being turned off at the regulated hours. Service pipes to buildings should, where possible, be so arranged that the cocks may be in the entrance passages. External lamps and other all-night lights provided at the public expense, should be supplied direct from the mains.

Branch mains should be cut off by means of screw-down valves of approved pattern.

Wrought-iron movable keys, in duplicate, should be provided to each size of valve and stop-cock.

All external stop-cocks and valves should be protected by cast-iron cover boxes, supported on a brick or concrete base, having a 2-in. raised block letter "G" cast on them, and placed, whenever possible, where they will not be subject to wheeled traffic. All internal valves should be protected by gas-cock cupboards, lettered "Gas." The key should be common to all gas-cock cupboards. Gas-cocks, when in locked cupboards, should have fixed handles.

Syphons.—Syphons, commonly called "drip-boxes," of cast-iron, the full size of the mains, and placed in brick pits, are required at intervals and at the lowest levels of the line where water is likely to accumulate. They should have cover boxes lettered "G.S."

Hot Water Systems.

Hot water systems are required either for warming, or for the supply of hot water, or for both purposes.

They are of two distinct types, viz. (I) closed, or high pressure, and (II) open, or low pressure.

The former is suitable for warming purposes alone, and it is not treated further of here, as, when adopting it, it is best to obtain tenders from approved firms making a speciality of this class of work, who will make their own proposals and plans, subject to the conditions which may be specified.

The latter type is suitable for both warming and hot water supply. In large systems special combined apparatus may be used, or there may be a separate boiler for each purpose, and for such systems tenders should be obtained as in the case of high pressure systems (see above); but for small *household* systems one boiler, sometimes that of the kitchen range, is sufficient; and it is to these small systems that the following remarks more especially apply.

Boilers and Cylinders.—In systems for hot water service where the boiler is of small capacity, such as the boiler of a kitchen range, a hot water cylinder should be provided near to the boiler, and a little above the level of its top.

A hot water system for heating only, does not require a hot water cylinder.

The boiler should have a safety valve, draw-off cock which can be used for testing, and a handhole for cleaning purposes.

Cold Water Supply.—The cold water supply to the system should be by means of a feed cistern fixed a few feet above the highest point the hot water is required to reach. The feed cistern should be supplied by a ball-cock commensurate with the aggregate waterway of the taps likely to be drawn from at the same time, and should be connected, by a pipe of the same size, with the return pipe at a point close to the boiler.

Connections.—The flow pipe should start vertically from the crown of the boiler, care being taken that it does not project at all within it: and the return pipe should be connected with the lowest part of the side, or walls, of the boiler, at an easily accessible point not exposed to the direct action of the fire. If there is a cylinder, the flow pipe from the boiler should enter it low down at the side, not at the bottom, while the return pipe from it to the boiler should be taken off from a point in or near the bottom of the cylinder, and should enter the boiler near the bottom, either separately or in conjunction with the return pipe of the general system. The flow pipe of the general circulating system should be taken off the top of the cylinder, care being taken, as in the case of the boiler, that there is no projection within. The return pipe of the general system should be taken directly back to the boiler, just as if there were no cylinder.

To ensure good circulation, it is very important to avoid dips in the flow pipe and rises in the return pipe. However slight it may be in places, there should everywhere be an inclination, upwards in the former, and downwards in the latter, of at least 1 in. in 10 ft., if possible; and from the highest point of the circuit an escape pipe for air and steam should be carried up to a level a little above that of the top of the feed cistern, and should discharge in the open air, the end being turned over, so that the opening may point downwards, and not be likely to get stopped up with dirt.

If dips and rises are absolutely unavoidable, there should be a similar escape pipe from the summit of each rise, and means of emptying the pipe at the bottom of each dip.

It is desirable that all service pipes should be taken off the flow pipe, though for the sake of economy and simplicity it is often advisable to take some of them off the return pipe. In either case they should fall, however slightly, all the way to the tap or taps they serve.

When a long service pipe is unavoidable, in order to prevent the water in it getting cold, it should be returned to the pipe of the circulating system from which it is taken, so as to get circulation through it.

All circuits, however, should be arranged so as to make the service pipe as short as possible.

If, in order to secure this, it is necessary to have more than one flow pipe, each of them should start from the hot water cylinder, or from the boiler if there is no hot water cylinder; but they can all be connected with the same return pipe, if convenient.

When two or more circuits are thus provided, stop-cocks should be fixed to allow of either of them being cut off for repairs, and also to regulate the circulation, which is often found to be more rapid in one circuit than in the others.

Frost, precautions against.—The feed cistern and supply to it should be carefully protected from frost, so that there may be no chance of an accident from the water supply being frozen.

As a further safeguard, a water-gauge is sometimes attached to the hot water cylinder, or to the boiler when a separate boiler is used without a hot water cylinder.

Steps must also be taken to ensure a sufficient supply to the feed cistern on occasions when the general water supply to the building is cut off.

Pipes.—All pipes passing through walls should be free of the masonry, so as not to be rigidly fixed, and all pipe holes should allow of a little play and movement of the pipe.

No hot water pipes should pass through W.C.'s except for the purpose of warming the same, in which case the holes in the walls through which the pipes pass should be carefully packed with silicate cotton.

Pipes should not, as a rule, be laid in channels in the floor covered with iron gratings, as dust and dirt get swept through the latter; they should generally be kept 6 in. or 7 in. above floor, so as to allow of sweeping under them.

All pipes not intended to radiate heat should be lagged, *i.e.*, covered with a suitable non-conducting material such as silicate cotton or patent plastic covering, and should be cased where exposed to view, for the sake of appearance. The hot water cylinder may be similarly protected, if necessary.

Flow and return pipes should never be less than 1¼ in. in diameter, and may run from that size up to 3 in., though it is seldom necessary to go beyond 2 in.

If the water is hard or throws down a deposit, larger pipes should be used, both for circulation and service, than would otherwise be necessary.

Wrought-iron pipes should be galvanised wrought-iron steam pipes of best quality.

All changes of direction should be by bends, not elbows.

Expansion joints should be provided where necessary, but when the lengths are not great, right-angled changes of direction will give enough play to take up the contraction and expansion of the pipes without special expansion joints.

If cast-iron pipes are employed, it is best that they should have flanged joints in cases where the pressure is great. If socket pipes are used, they should have rust joints instead of being run with lead, and the joints should set thoroughly hard before the apparatus is charged. Cast-iron pipes should be coated with Angus Smith's composition, and all expansion will have to be taken up by expansion joints.

Radiators and Coils.—For heating, each firm will probably recommend its own coil or radiator. Those are best, on the whole, which are most easily kept clean, and afford fewest corners for retention of dust, which is found to collect near hot water pipes: swinging radiators are the best in this sense.

In a heating system, the greater the pressure of water, the greater will be the radiation.

Radiators or coils should not be placed too near woodwork. It is frequently desirable to have inlet ventilators in connection with them, so that they may warm the fresh air entering the room.

With radiators, air cocks take the place of escape pipes. They should be so arranged that a squirt of water from them will not be likely to damage adjacent furniture, &c.

The wall space behind a radiator may be faced with tiles to facilitate cleaning.

Hot Water Systems—*contd.*

Repairs and Cleaning.—There should be draw-offs from the bottom of the boiler and cylinder and at the lowest point of the return pipe, to enable the whole system to be emptied for repairs and cleaning. They should not be in the form of taps, but brass screw plugs, with loose lever handles, and with an actual lock, if considered necessary, so as to prevent interference by unauthorised persons. A similar precaution should be taken in the case of any stop-cocks on the flow and return pipes. If the water throws down much deposit, frequent cleaning is necessary in a hot water *supply* system. Occasionally, where the water is very hard indeed, it has been found desirable to make an examination as often as every four or five months.

Ventilation.

General Principles.—Ventilation is far too large and complicated a subject for full discussion here, but its great importance renders a brief reference to principles desirable before proceeding to outline W.D. practice.

In so far as inhabited rooms are concerned, the air is vitiated by the respiration and perspiration of the occupants, by exhalations from the sick, and by the combustion of the fuel and lighting agents employed.

To maintain a reasonably high standard of purity in a room, it is usually considered that some 3,000 cub. ft. of fresh air per inmate, taken from a pure source, are required every hour; and it is essential, in order to avoid discomfort, that the foul air should be extracted, and the fresh air admitted and equably diffused, without inducing draughts, which are usually felt when the rate of movement exceeds 3 ft. per second.

Experience shows that the air of a room can never be completely changed more often than five or six times, and practically in temperate climates not more than three times, in the hour, without causing inconvenience to the occupants.

In some climates the necessity of avoiding either undue cooling or excessive moisture adds to the difficulties to be encountered.

It should be borne in mind that a good blow through from open windows is the best ventilation of all, and no amount of special ventilation will entirely make up for the absence of it. The position and design of the windows is therefore an important point. In large rooms with flat ceilings lofty windows with the upper lights arranged to open are the most satisfactory. It is sometimes desirable to provide for the admission of fresh warm air, either by inlet ventilators behind radiators ~~or special pattern grates or or stoves.~~

From the foregoing it is clear that ventilation is intimately connected with considerations of cubic space, with the system of warming, and the method of lighting. Further, the conditions may vary materially with climate, position, and aspect of buildings, character of occupation, and the number and habits of occupants.

System of Ventilation in W.D. Buildings.—As a general rule every room intended for habitation or for occupation, whether of short or long duration, should be independently ventilated, and separate means of maintaining the purity of the air should be provided for passages and staircases.

In special cases, for which see "Section III," viz.:—Barrack Rooms, Cells, Prisoners' Rooms, Schoolrooms and Stables, the amount of inlet and outlet ventilation is regulated according to fixed rules, but in other cases it is largely a matter for judgment, varying as it does from the relatively small needs of Officers' Quarters and Stores, to the large requirements of Recreation Rooms, Canteen Rooms, Tailors' Shops, &c.

Outlets.—Adequate exits must be provided for the escape of the vitiated air.

In rooms having fireplaces the chimney flue is the natural outlet, and this in some cases may alone suffice. Outlet ventilation for single story buildings or upper floor rooms may be arranged for by ridge ventilation, or by wooden trunks carried up through the roof from the ceiling, preferably from above the gas lights.

Inlets.—Doors, windows, &c., act as inlets to some extent, but when these natural inlets are insufficient they must be supplemented by special fresh-air inlets. These are usually taken through the walls, and are finished on the outside with perforated bricks, or movable iron gratings, and on the inside with louvred frames or valves giving control over the ingress of the air. As a rule, it should not be possible for the occupants of a room to completely close the inlet ventilators.

Air Shafts generally.—Air shafts should have smooth sides with rounded-off angles, be as short and as nearly straight as practicable, and be provided with removable gratings, or other contrivances, at their outer ends, to keep out birds, &c. These gratings should be large enough to allow of their interstices giving the full required area of the duct. They should admit of easy cleansing, and always be kept as free as possible from dust and dirt, which not only destroy the purity of the air, but also impede its movement.

Rules for Outlets.—In all cases the outlet ventilation given by smoke flues should be taken into account, and these flues need not be supplemented by special outlet shafts so long as they afford 20 to 30 sq. in. of outlet area to each nightly occupant in bedrooms.

In rooms for day use, or for occasional occupation, 10 to 20 sq. in. of outlet area per occupant will suffice.

Outlets will be close below ceiling level.

Outlet shafts in brickwork or masonry should be rendered in cement, and be carried, where practicable, near smoke flues—between two if possible—to aid the up-draught. It is, however, desirable to have the outlet at a distance from the warm-air inlet of the rooms, where such exists, and when both are in the same chimney stack the openings should be as far apart as possible.

Fixed louvres should be placed at the foot of the outlet shaft, except when it is over a bed, a position which should, as a rule, be avoided, on account of down-draughts; in this case mica or other flap ventilators may be used. The upper end of the shaft should terminate in a horizontal passage right through the stack, between the necking and cap, with apertures fitted with air bricks. This passage, which may serve more than one outlet shaft, should be of such a size that the air bricks on either side will give a clear outlet area equal to the aggregate cross-sectional area of the shafts.

Rules for Inlets.—In most cases the natural inlet ventilation afforded by windows, doors, &c., should be taken into account, and this may be taken to satisfy requirements in all cases where under the rule for outlets the smoke flues are considered to suffice, and it may be assumed as a general rule that the aggregate cross-sectional area of the special inlet ventilators need not exceed that of any outlet shafts supplementing the smoke flues.

To avoid draughts, cold fresh air from special inlets should be admitted in an upward direction, the openings being at a height of at least 6 ft. from the floor, and where more than one inlet is required, they should, if practicable, be in opposite walls.

On plans of buildings, the large-sized W.D. pattern louvred ventilators, which have a clear area of 20 sq. in., should be distinguished by the letters "L.V." and the small-sized ones, of 10 sq. in. clear area, by "l.v." Fixed air-gratings to Cellars, spaces under floors, &c., should be indicated by the letter "V."

Louvres.—Where fixed internal louvres are used, they should be set "up-cast" to the room, at an angle of 45°, the upper edge of each louvre just covering the lower edge of the one above, so that the incoming air may be directed towards the ceiling.

External louvres should be set, half covering, at an angle of not less than 60°. In exposed situations louvres will not keep out driving rain or snow, and steps must be taken to prevent the drift causing damage.

Water Supply.

General Principles.

Source of Supply.—The supply of water to Barrack Buildings may be arranged for either from independent Water Works in Royal Engineer Charge, or from the mains of a Water Company.

When new schemes are being considered, it is of great importance to weigh fully the advantages and disadvantages of the various possible sources of supply, having due regard to the purity of the water as ascertained by chemical and biological analysis, the engineering works necessary, and the comparative cost.

"The Water Supply of Barracks and Cantonments," by Lt.-Col. G. K. Scott-Moncrieff, R.E., will be found useful in the preparation of schemes, and gives a list of books of reference.

Amount of Supply.—It is first necessary to ascertain as closely as possible what the probable requirements will be, and a table should be drawn up showing the total number of men, women, and children, and horses to be supplied and the daily allowance of water proposed for each; which should fall within the maximum allowance given by King's Regulations, viz., 20 gallons for each officer, man, woman, or horse, and 10 gallons for each child. Allowance should be made for any extension probable.

No daily allowance for fire reserve purposes need be added, but the scheme should be so arranged that a sufficient reserve for this purpose may be immediately available.

Supply from Source to Barracks.

Storage Reservoirs.—Storage reservoirs will be of different types to suit local circumstances; when built of masonry or concrete it will be advisable to make them of two compartments; a solid foundation is essential, and reservoir sites should be examined by numerous trial holes with this in view.

Pumps.—Pumps, and the engines which drive them, should be in duplicate, or with two sets in work and a third standing in reserve. The pumps in work will usually be calculated for delivery of the daily supply in eight hours.

Mains.—The supply mains will usually be of cast-iron pipes, either with turned and bored, or with plain spigot and socket joints, both caulked with lead, flange joints being used for the connections to meters and valves, and in all vertical work. In cases where the static head on the main may amount to over 250 ft., steel pipes with collar joints will be used.

All mains should be tested to double the working head, and the joints made secure against the working stress due to shocks in the main from pumping or closing of valves.

Each section of the main will be carefully graded, and the whole laid to a continuous fall where possible; scour valves will be placed at any dips and air valves at any high points; in the case of long lengths at a continuous fall, valves will be provided to divide the main into sections of suitable length, so that the whole main need not be emptied for repairs at any one point.

Distribution to Barracks.

System of Supply to Barracks.—The supply system is either "constant"—in which case the taps and other services are directly connected with the mains, no cisterns being provided except for water-closets, hot-water apparatus, boilers, &c.—or "intermittent," in which case every building is provided with a cistern with a capacity of one or two days' supply for the occupants.

On account of sanitary advantages, a constant service is much the more desirable and should always be arranged for if possible.

(*a*) Constant service. A service is considered constant when the Water Company can guarantee a continuous sufficient supply, and adequate pressure at all points of the system at all times of the day or night, or where there exists under the control of the Military authorities a service reservoir filled from the main and of sufficient capacity to continue the supply during the time that the service from the main is insufficient; usually to cover contingencies, such a service reservoir should be made to contain two days' supply for the whole Barracks; it should be at such a level that it will command all the buildings, and will be made in two compartments.

With a constant service no cisterns will be provided in any buildings for the storage of water for general purposes, but to avoid accidents or inconvenience, cisterns providing one day's supply for the flushing of Latrines, Urinals and Closets (irrespective of the small water-waste preventing cisterns), and feed cisterns providing one day's supply for all boilers for hot-water apparatus, will be arranged so that the supply to these fittings will always be drawn through these cisterns.

All taps and fittings from which water for drinking purposes might be drawn, will be taken direct from the mains.

With the constant service, as the pressure on the taps and fittings in the lower parts of the system may be considerable, care must be taken to prevent loss by leakage, and all fittings must be of first class quality and proved under pressure.

Care is necessary to proportion the service pipes so as to provide for the event of taps at different levels being used at the same time, and as the cutting off of the supply is attended with great inconvenience, the protection of the system from frost is of special importance.

(*b*) Intermittent service. A service is said to be intermittent when the Water Company is not in a position to guarantee a constant supply, and no high level service reservoir has been provided to render the service to Barracks equivalent to a constant supply. Under such circumstances it will be necessary to provide cisterns for the storage of water for general purposes in the buildings. Such cisterns may, where the supply is nearly constant, be for one day's supply; but where it is liable to much interruption they should hold two days' supply.

Service Reservoirs.—Service reservoirs up to about 10,000 gallons may often be constructed of cast iron; but above that size, when they have to be raised above ground, they will usually be of steel and may advantageously be made circular in form, to avoid the need for internal staying and reduce wind pressure; when a sufficiently elevated site is available in the vicinity of the buildings, masonry or concrete reservoirs will be most suitable.

All service reservoirs should be made in two compartments, to enable one to be cleaned whilst the supply is continued through the other; in the case of circular steel tanks this may be arranged by a second concentric ring.

Each compartment will be fitted with supply and delivery pipes and scour and overflow, and a by-pass round the reservoir will be arranged.

Service Mains and Branches.—Distribution or service mains should be calculated to give the delivery required, allowing for the whole daily supply to be drawn off in eight hours, due allowance for incrustation of the pipes being made; and where the same mains act as fire mains and service mains, the size required for fire is the minimum to be given.

Cast iron piping will ordinarily be used for all work outside buildings, except for branches carrying a small supply, which may be of galvanised wrought-iron; cast-iron pipes of less than 3 in. diameter will not be used.

When Barracks cover a great area or are situated at great differences of level, it is often advantageous to provide separate service reservoirs to command groups of buildings, or break-pressure tanks may be used, as it is undesirable that more than 250 feet of head should be brought to bear on any part of a distribution system.

The mains should be divided into wards or districts, each controlled by a valve. To arrange this

Water Supply— *continued.*

satisfactorily will often require much consideration. Due regard should be given to possible future extensions, and it should also be borne in mind that the branch mains should be connected at their extremities so as to avoid dead ends and allow the water to circulate freely. This may often entail some extra initial outlay, but the gain in preventing the stagnation of water is well worth it; and there is the further advantage that it provides alternative routes of supply, which may often be found useful during repairs to the mains.

Every part of the water supply system should be controllable by means of stop-cocks or valves, and it should be so sub-divided as to facilitate cutting off the supply to any one or more parts without interference with the remainder. This is necessary to limit the waste due to a sudden burst or leak, to enable repairs to be carried out, to facilitate the detection and localisation of leakage generally, and, in the case of mains, to enable the whole supply to be concentrated, in the event of fire, upon the particular hydrants in use.

Every building should have a separate supply pipe controlled by a stop-cock, which is best placed in a surface box immediately outside the building, which must be carefully protected from frost.

All pipes should be laid with a fall to some tap, emptying cock, wash-out valve, or hydrant acting as such, so that it may be possible to empty them completely, and, when it can be avoided, there should be no upward bends in them in which air can lodge.

Stop-cocks and Valves.—Stop-cocks should be of the kind known as "brass round way, screw bottom"; valves should be "high pressure slide" or "sluice" valves, proved to a pressure equal to that required for the mains, and of the same size.

Meters.—A meter will be fixed at the entrance to Barracks, to register the amount of water obtained from a Water Company or delivered from the head works, and also at the point of departure of any large section of a system. Meters should not be larger than is necessary to register the ordinary daily consumption, as large meters are very costly, liable to check the supply when most wanted, and not reliable for small amounts. Usually a size of 1½ in. to 2 in. will suffice for a Battalion Barrack; but the loss of head permissible should be taken into account in fixing the size.

A bye-pass of full bore should always be provided for use in case of fire with valve under seal.

In the case of important sections, a second bye-pass should be arranged for the occasional fixing of a waste detecting meter, such as Deacon's.

Cover Boxes.—All meters, valves, fire-cocks, or hydrants should be protected by cast iron cover boxes supported on a brick or concrete base, with hinged lids, having 2 in. raised block letters cast thereon viz., "W.M." for water meter, "V" for valve or stop-cock, and "F" for hydrant, and placed whenever possible where they will not be subject to wheeled traffic.

Salt Water Supply.—When salt water is used for flushing or other purposes, all fittings in connection with it should be of gunmetal instead of brass.

Soft Water Supply.—When the general water supply is hard it is often desirable to provide rainwater tanks.

Underground soft water tanks supplied from roofs should be sufficiently ventilated and constructed with filters. No overflows from underground tanks of any kind should ever be connected with foul drains. The outlets to them in the tanks should be protected with galvanised iron gratings to keep out rats and other vermin.

At Home, in cases where the consumption is fairly uniform throughout the year, the tanks will be of sufficient size if they contain one-fourth of the annual rainfall on the roofs or surfaces supplying it.

Protection from Frosts.—Pipes underground should be laid at such a depth as to be safe against frost as well as damage by traffic. The depth should never be less than 18 in. reckoning from the top of pipe, even in the mildest parts of England and Ireland; but each case should be carefully considered and decided locally, as it is frequently necessary to exceed the above depth; arrangements for emptying the pipes above the protected level should be made as described above.

Cisterns.—The capacity of cisterns may be calculated by the following allowances:—

Fittings.	One day's supply.	Two days' supply.	
	Gallons.	Gallons.	
Ablution and Lavatory Basins ..	20	40	per basin.
Baths	200	400	per bath.
Latrines or Soldiers' W.C.'s	40	80	per seat.
Taps in Yards	40	80	each.
Urinals	40	80	per stall.
W.C.'s, other than Soldiers'	30	60	each.

And also the quantities named for the following buildings in addition to the quantities given by the calculations above, viz.:—

Building.	One day's supply.	Two days' supply.	
	Gallons.	Gallons.	
Canteen	¼	½	per head on barrack accommodation for N.C.O.'s and Men.
Cook Houses	1½	3	per head on barrack accommodation for unmarried men.
Laundry	40	80	per trough.
Married Soldiers' Quarters	40	80	each.
Officers' Mess	20	40	per Officer.
Married Officers' Quarters	100	200	each.
Single Field Officers' Quarters ..	30	60	each.
Single Officers' Quarters	20	40	each.
Quarter-Master's Quarter	50	100	
Provost Prison	5	10	per cell.
Recreation Establishment	½	1	per head on barrack accommodation for N.C.O.'s and Men.
Serjeants' Mess	5	10	per Warrant Officer and Serjeant.
Stables	8	16	per horse.
Wagon Sheds	5	10	per vehicle.
Warrant Officers' Quarters	50	100	each.
Workshops for Armourer	25	50	

Water Supply— *continued.*

As a rule, galvanised wrought-iron is the best material for all cisterns from 50 up to 800 gallons. Lead lined cisterns should not be used. Near the sea, or where the water contains nitrates, slate cisterns may be necessary.

Cisterns supplying Water Closets, Latrines, Urinals, and Slop Sinks should be separate from those supplying water for other purposes. The separation may be effected by using flushing cisterns. Those for drinking and cooking water should not be placed where they would be exposed to foul air or other pollution.

All cisterns should be fixed at a sufficient height to give a full supply to the highest draw-off tap, should be easy of access, and should have covers, the portion of which immediately over the ball-cock, extending the full width of the cistern and 1 ft. 8 in. in length, should be hinged so as to give easy access for examination. If they can be placed in a well-lighted situation, so much the better.

Cisterns should be protected from frost. This can sometimes be done by putting them against chimney stacks and boxing them in. If some such method cannot be adopted, it is necessary to felt and case them. All cisterns should be under cover if possible, those for Latrines or Urinals or other outdoor services can often be put in the roofs of adjacent buildings. If placed where leakage or overflow would cause damage, they should be provided with lead safes.

Connections to cisterns should be made with brass screw unions with double nuts, and there should be a stop-cock on the falling pipe as close as possible below the cistern.

Each cistern should be supplied by means of a high-pressure ball valve of approved pattern, and a waste should be provided, large enough to take the full delivery of the supply.

Pipes and Stop-cocks.—Wrought iron piping (galvanised) with screwed joints will usually be used for all internal work. Lead pipes should, however, be used between cisterns and Water Closets, Slop Sinks, and Urinals, where the use of wrought iron pipes may be difficult. It is undesirable to use lead for service pipes; it should never be used for soft water, which often acts on the metal and may cause lead poisoning.

Pipes above ground should be easily accessible throughout. They should, as far as possible, be kept on interior walls at a distance from windows and ventilating openings. When necessarily placed in exposed situations (as in cold passages) they should be properly lagged, to protect them from frost. Whenever water pipes exposed to view are lagged, they should also be cased for the sake of appearance.

The whole of the service pipes in each building should, if possible, have a fall towards the lowest tap in the building, whilst the rising pipe to the cistern should have a continuous fall towards a draw-off tap placed in the surface box containing the stop-cock controlling the supply to the building. An air valve should be provided at the highest point of the rising pipe, if a cistern or a tap does not act as one.

Taps.—Taps should be of the following sizes, viz.:—1 in. diameter for baths, ¾ in. diameter for supplying drinking cups, ½ in. for soldiers' ablution benches, and ¾ in. for sinks and all other purposes. When the water is free from grit, Lord Kelvin's pattern of tap should be used in Ablution Rooms and similar places, on stand pipes, and in situations where rough usage may be expected. In all other cases brass screw-down taps of best quality should be fixed.

Fire System.

Fire Reserve Tanks.—When the water supply is not constant, or is insufficient in quantity for fire purposes, and when no service reservoir in the vicinity of the Barracks has been provided, it will be necessary to provide a special fire reserve tank. The capacity of such a tank to be carefully considered with regard to the local conditions in each case. Underground tanks are sometimes arranged for use with fire engines.

Fire Hydrants.—For ordinary barrack buildings it may be taken that, where fire engines are to be used, a building is sufficiently protected if every portion of it is covered by two hydrants at a range not exceeding 300 feet; but in the case of important store buildings more protection is desirable, and for unimportant buildings one hydrant within the same distance may suffice.

Hydrants should not be within 30 ft. from the buildings, and they are best placed at crossings or near corners of buildings. In cases where the head is sufficient for fire engines to be dispensed with, it is desirable that the hydrants should be somewhat closer together than stated above.

Fire hydrants may be fixed on a short 3 in. branch from the larger fire main; where no inconvenience is caused, pillar hydrants may with advantage be used, as they are more conspicuous and do not get covered by snow.

The double-headed copper standpipes (1½ in. and 2½ in. diameter) are supplied by the Army Service Corps and held on inventory by the troops. The screws of the hydrants, as obtained from the maker, are cut to the 2½ in. Metropolitan Fire Brigade gauge, and the 2½ in. standpipes fit them. The hydrants should have gunmetal connecting collars to fit the 1½ in. standpipe, and the local fire brigade gauge, if different from the Metropolitan. These collars should be secured to staples in the side of the hydrant pit by chains attached to them, in the same way that the chain is attached to the cap of the hydrant.

The position of all hydrants should be conspicuously marked. It is desirable, therefore, in addition to the distinctive letters on the cover boxes, to affix cast iron or enamelled iron labels, indicating their position, on the neighbouring walls high enough up to prevent their being covered by snow.

All fire-cocks (hydrants), valves and stop-cocks on mains, branch mains and supply pipes to buildings should have a spindle head, so that they may be all controllable by one and the same key. Four movable wrought iron keys to fit the above should be provided for each Barrack; one for the Army Service Corps, one to be hung up in the Regimental Guard House, one to be hung up in the Fire Engine House, and one to be kept by the R.E. In cases where different sizes of spindles exist in the same Barrack, they can be rendered controllable by the above keys by fixing on a special adjusting cap.

Fire Mains.—The fire mains, whether fire engines are used or not, will in ordinary cases be calculated to deliver 120 gallons per minute at each hydrant which may be expected to be in use at the same time; in ordinary cases this may be taken as two, the main should, therefore, carry 240 gallons per minute, which will be sufficient to supply two good sized manual engines, or where no engine is used, four jets each of 60 gallons will be available to play on the fire.

The supply for the service of fire hydrants will usually be taken from the ordinary supply system, but in some cases separate fire mains carrying water unsuitable for domestic use may be arranged. In either case, it is essential that the fire mains should be of ample dimensions to supply with sufficient residual head the large amount of water which may suddenly be drawn off in case of fire.

Where sufficient head is available from the service reservoir, or fire reserve tank, to give at the hydrants enough residual head, when the required number are working simultaneously, to force the jets over the highest buildings, it will always be desirable, if excessive sizes of mains are not entailed, to arrange for a fire protection scheme independently of the use of fire engines.

If this cannot be done, the mains must be arranged to deliver the water to the fire engines, which will lift it to the required height.

Speaking generally, it will be found that the principal mains for a Battalion Barrack should not be less than 6 in., and branch mains not less than 4 in., with short branches of 3 in. pipe to each hydrant; but each case must be calculated according to the local conditions.

In cases where special protection is required, and for the supply of steam fire engines, larger mains will be necessary. The steam fire engines used by the London Fire Brigade are capable of delivering 260 to 450 gallons per minute each, and larger sizes up to 1,000 gallons are made. The Aldershot Camp Fire Engine is of 260 gallon size, and can throw a jet from a nozzle ⅛th in. in diameter to a height of 160 feet.

Fire Buckets.—As a first aid in case of fire in storehouses distant 200 yards or more from a Guard Room or other place where fire appliances and help are readily available, buckets will be kept just outside the building. Buckets are obtained from the Army Service Corps and held on inventory by the troops, any hooks necessary for hanging them on being supplied as fixtures.

Section II.

DETAILS OF CONSTRUCTION.

Ash Bins.

Portable bins are best, the bins, with their contents, being frequently removed and clean empty ones left in their stead.

All bins should stand on cement concrete platforms. A capacity of 1 cub. ft. per grate, or 2 cub. ft. per Married Soldier's Quarter is sufficient.

Baths.

Baths should not be boxed in.

Hot and Cold Water Supply.—It may be accepted as a general rule that, at Home Stations, both hot and cold water should be laid on to all authorised baths; Bath Rooms in Quarters should be arranged so as to be over the Kitchen, or not a great distance horizontally from it.

Wastes.—In Bath Houses for N.C.O.'s and men the baths should empty (through a 2-in. outlet) into surface channels in the floor, discharging, as directly as possible, through the wall by a stoneware or iron pipe, bedded and made good in asphalte, and projecting 1½ in. beyond the face of the wall over a gully or hopper head.

The wastes from all other baths should be at least 1½ in. in diameter, and should be large enough to carry off the hot and cold supplies turned full on together; they should be trapped and should discharge in the open air over a hopper head or gully. It is best to arrange for the discharge to be immediately *below* the grating of the gully, so as to avoid choking it with soapsuds, &c., and thus causing an overflow. In order that the wastes may be short, the baths should be placed near external walls.

Bells.

Where few bells are required, where the distance between bell-pull and bell *is* short, and where the wires can be arranged with but few cranks, ordinary bells may be used. In most cases, however, electric bells will be found cheaper and better.

Ordinary Bells.—These should be 3½ in. in diameter, each should be fitted with a pendulum and should be distinguishable by their tone.

Electric Bells.—It is important that every system of electric bells should be carefully installed, and that no inferior materials should be used; otherwise much inconvenience and trouble will result.

The wire should be copper, tinned and insulated throughout. For ordinary work the gauge should be No. 20 S.W.G. Twin wire is not to be used.

The bells should be of two sizes, viz., "large" with 4-in. gong; and "small" with 3-in. gong. The former are suitable for front door circuits, which should preferably not be connected to the indicator board.

One indicator should be provided for each circuit, except those fitted with separate bells.

Batteries should be of the Leclanché form. They should be placed in as cool a place as possible. The number of cells provided should be double that required to work bell and indicators satisfactorily, when the cells are freshly made up.

Ceilings.

All ceilings, when not otherwise specified, should be plastered, and finished plain without cornices.

Ceiling Joists.—Ceiling joists should, as a rule, be spaced 12 in. centre to centre, as that spacing suits the ordinary length of laths. They should be 2 in. thick, and their depth should equal ½ in. for every foot of bearing.

Cellars.

Beer and Wine Cellars should be dry and well ventilated, but there should be no windows, as it is necessary to ensure an equable temperature, and as darkness is better than light for both wine and beer, direct sunlight especially being hurtful.

Unless absolutely necessary, the floors should not be drained, and slop-water should be mopped up; but if water makes its way into the Cellar, so that a drain is essential, it should discharge in the open air over a yard gully if one is available at so low a level, or into an open channel leading to a small pit outside, that can be emptied by hand.

Barrel-ways to Cellars should have a clear opening 3 ft. 6 in. wide by 4 ft. 6 in., for the admission of butts, or, in the case of small Cellars, 3 ft. wide by 3 ft. 9 in., for half-butts or hogsheads.

Doors and Gates.

The doors most commonly used in W.D. work are as follows:—

Class.	Description.	Furniture.
¾ in. ledged and braced	Of ¾ in. deal battens with two ¾ in. ledges and ¾ in. braces hung to 4 in. × 3 in. rebated frame, cast iron shoes to door posts	Iron cross-garnet hinges, Norfolk thumb latch, 6 in. tower bolt on inside in case of outdoor W.C.'s.
1 in. ledged and braced	Of 1 in. deal with three 1 in. ledges and 1 in. braces hung to 4½ in. × 3 in. rebated frame, cast iron shoes to door posts	Iron cross-garnet hinges, Norfolk thumb latch, dead-shot lock.
2 in. framed and braced ..	Of 2 in. deal, filled with 1 in. battens, ploughed, tongued and V-jointed, frame and braces stop-chamfered, hung to 4½ in. × 3 in. rebated and twice chamfered frame, cast iron shoes to door posts	Three 4 in. wrought steel butt hinges, Norfolk thumb latch, dead-shot lock, with top and bottom iron barrel bolts when hung folding.
2 in. panel, flush on outside ..	Of 2 in. deal with panel bead flush on outside and square framed on inside, hung to 4½ in. × 3 in. rebated and chamfered frame, cast iron shoes to door posts	Three 4 in. wrought steel butt hinges, iron rim lock with brass furniture. Where hung folding, top and bottom iron barrel bolts.
1¼ in. or 1½ in. panel, square both sides	Of 1¼ in. or 1½ in. deal with square framed panels without mouldings, hung to 1½ in. double rebated jamb linings, finished with chamfered fillets in the case of unplastered walls and architraves on grounds with plastered walls	Two 4 in. wrought steel butt hinges, iron rim lock with brass furniture.
1¾ in. or 2 in. panel, moulded both sides	Of 1¾ in. or 2 in. deal with square framed panels and planted panel moulds, hung to 1½ in. double rebated jamb linings finished with architraves on grounds	Two 4 in. wrought steel butt hinges, mortice lock, with selected hardwood or brass finger plates and furniture.
Special design	For entrance doors in the case of important buildings	—

Doors should, as a rule, open inwards, except in cases where the possibility of a panic in case of fire has to be provided against; doors of Coal Stores should open outwards. Doors of rooms should preferably be hung on that jamb which enables them best to screen the interior from view when partly open. In a Sitting Room the screening of the fire, and in a Bedroom the screening of the bed, should be first considered.

Self-closing Doors.—Doors of Lavatories and Water Closets should generally be hung with rising butts, or be fitted with some self-closing arrangement.

Self-opening Doors.—Doors of Soldiers' Closets should be made self-opening by fixing the hinges slightly out of the perpendicular.

Sliding Doors.—In many cases such doors are preferable to gates, as being less liable to damage. The best forms are those in which the whole of the weight is carried above.

Swing Doors.—Where used should be hung on proper hinges with centre and spring, and provided with stay hooks for fastening them open. The spring bolt of the lock should be bevelled on both sides, to allow the door to swing. It is usually desirable to have a glazed panel in the upper part of a swing door so as to prevent collisions.

Dimensions of Doors.—The normal sizes of internal doors are 7 ft. by 3 ft., 6 ft. 10 in. by 2 ft. 10 in., 6 ft. 8 in. by 2 ft. 8 in., and 6 ft. 6 in. by 2 ft. 6 in.; but in the case of Water Closets, Water Closet Lobbies, Lavatories, Larders, &c., a width of 2 ft. 3 in. will suffice, and for outside Water Closets a width of 2 ft. 1 in. is suitable.

For doors over 3 ft. in width a good proportion will be obtained if the height is made 7 ft. with the addition of half the excess in width over 3 ft.

Doors Hung Folding.—Doors over 4 ft. in width should be hung folding.

Door Openings.—The quoins to door openings should be rounded off or finished with bull-nosed bricks, unless the opening is finished with architraves or fillets.

Fanlights.—Should generally only be provided when light is required, and will usually be hung to open inwards.

Frames, Jamb Linings and Finishings.—All door frames with stone or concrete sills should have cast iron shoes of ⅜-in. metal, 3 in. deep, with a tenon 1 in. cube on the under side let into the sill and run with lead. Internal doors to unplastered walls, as a rule, should be hung in frames, bedded and pointed in hair mortar, but in walls under 14 in. in thickness jamb linings, not less than 1¼ in. thick, may be used having 3 in. by 1 in. double chamfered fillets fixed round both edges as architraves. In plastered walls, the jamb linings should be finished with grounds and moulded architraves, or with grounds and double chamfered fillets as architraves.

Doors and Gates—*contd.*

Guard Stones.—Guard stones should be provided in the case of doorways or gateways for wheeled traffic.

Locks.—Stores of all kinds should have lever locks with differing keys. Plate Closets should have a 5-lever lock. Cell doors should have cell locks of approved pattern. Latchlocks should be provided for the entrance doors of self-contained quarters, and latchlocks, furnished with a stop latch inside, to the doors of the rooms of Single Officers' Quarters.

Mat Wells.—As mat wells are difficult to keep clean, it is better to omit them and to keep the door sill 1¼ or 1½ in. higher than the floor of the entrance lobby or passage.

Stay-hooks, &c.—All large doors and gates and all entrance or external doors should be provided with stay-hooks and eyes, or with proper catches or back fasteners for holding them open.

Stops.—Where the unrestrained opening of a door might cause damage, it should have a door-stop faced with indiarubber, and fastened to the floor in a position where it will not cause inconvenience. In some cases, such as entrance doors to narrow passages, a boxing to receive the door furniture may also be necessary.

Water-bars and Water-boards.—All entrance doors not protected by a porch should have water-boards, unless situated in very sheltered positions.

Much useful information as to details of joinery will be found in the S.M.E. "Notes on Doors and Windows."

Fireplaces and Flues.

Chimney Stacks.—The sides and divisions of stacks should usually be of 4½-in. brickwork. In lofty stacks containing only one row of flues, one long side of the stack at least should be 9 in. thick. The portion above the roof should be built in cement and sand. When the position is very exposed, it is better to make the sides 9 in. thick. In most cases plinths are better avoided.

Large stacks should, whenever possible, be arranged with the flues in a double row.

Foul air extract flues should, whenever possible, be placed between two smoke flues, so that the warmth of the latter may assist the up-current in the former.

Stacks rising through valleys and hips should be avoided.

Stacks at the eaves or on the slope of the roof should be at least as high as the ridge; stacks on the ridge should be at least 3 ft. higher.

Wide stacks rising from the eaves should, as a rule, be backed up by small span roofs to prevent accumulation of snow, &c., behind them,

Stacks should invariably be plastered within the roof spaces.

Fireplaces.—As a general rule those open fireplaces are best in which:—

i. There is the minimum of iron and the maximum of firebrick.

ii. The space between the bottom of the fire and the hearth is closed in by a movable shield so as to form a hot air chamber beneath the fire.

iii. The back and sides are of firebrick, the former leaning well over the fire and the latter flaring in plan, so as to radiate heat into the room.

iv. The depth of the front of the fire is a minimum. This is effected in some patterns of modern grates by the omission of the front bars.

Hearths.—All hearths should be of stone or of Portland cement concrete. When of concrete, they should be 4 in. thick on ground floors, and 6 in. on upper floors.

As a general rule the front hearth should project 18 in. in front of, and be from 30 in. to 36 in. longer than the fire opening.

Rules for protection from fire, woodwork about chimney flues.—Timber or woodwork should not be placed under any chimney opening within 10 in. from the upper surface of the hearth of such chimney opening.

The back of every fireplace opening in a party wall should be at least 9 in. thick from the hearth up to a height of 12 in. above the mantel.

Timber or woodwork should not be built into any wall or chimney breast nearer than 12 in. to the inside of any flue or chimney opening.

Timber or woodwork should not be placed in contact with the brickwork or stonework about any chimney or flue where the substance of such brickwork or stonework is less than 9 in. in thickness; when a less thickness is unavoidable, the brickwork or stonework must be rendered or the timber or woodwork kept at least 2 in. away from it.

Wood plugs should not be driven nearer than 6 in. to the inside of any flue or chimney opening, nor any iron holdfast or other iron fastening nearer than 2 in. thereto. This precaution is especially necessary in the case of skirtings running along the back of fireplaces or flues in adjoining rooms.

Smoke Flues.—Smoke flues should not as a rule be less than 14 in. by 9 in., but flues 9 in. by 9 in. will suffice for small stoves and for small rooms generally. They should be properly pargetted, and cored on completion. When linings are considered necessary, they should be of unglazed fireclay. No flue should change direction at a sharper angle than 120° without a soot door being provided for sweeping.

Stoves and *Stove-pipes.*—Hearths and trays should be provided for all stoves in wood-floored rooms. When, owing to hearths not having been originally provided, it is necessary to place stoves upon wooden floors, they should be placed on a base of stone or concrete; preference being given to the former. This base should be at least 3 in. in thickness, and of a size sufficient to show a margin of 6 in. around the stove. On upper floors, where the joists may not be sufficiently strong to bear the additional weight of a stone base, it will suffice to provide sheet iron with a layer or two of stout asbestos cardboard placed under it. This sheet iron should also be of sufficient size to allow of a 6-in. margin around the stove.

Stove-pipes should, whenever possible, be carried into a brick or masonry flue, and when it is absolutely necessary to carry them up through floors, ceilings, or roof, it is essential that extreme care should be taken to guard against the possibility of their causing a fire, by passing the pipe through the inside of a stoneware drain pipe, or using other means to safeguard the woodwork.

Floors.

The floors commonly used in W.D. work are as follows:—

Class of Floor.	Description and mode of laying.
Ordinary, 1¼ in. or 1½ in.	*Boards* in batten widths with straight joints laid with splayed headings and secured with cut flooring brads (two to each joist) of a length 1½ in. greater than the thickness of the batten.
Special, 1¼ in. or 1½ in.	*Boards* in 4½-in. widths laid with rebated joints and fillets and splayed headings. The fillets to be 1 in. by ⅜ in., painted one coat before being laid. The battens to be secured as above, and in addition the edges and rebates of each board to have a coat of thick white lead paint applied when laid and before being cramped up.
Solid wood 1¼ in. or 1½ in. ..	*Boards* in 4½-in. widths with straight joints secured to creosoted wood fillets bedded in concrete of one part cement to four parts of the aggregate and not less than 4 in. thick. In cases where there is a likelihood of damp penetrating the floor, the surface should be covered with a bituminous composition.
Thin wood block 1½ in.	*Wood blocks*, maximum size, 16 in. by 3 in.; where possible to be laid as well as supplied by an approved firm; laid on concrete not less than 4 in. thick.
Thick wood block 4 in. to 6 in. ..	*Wood blocks*, maximum size, 9 in. by 3 in., of creosoted deal or hardwood, laid with grain-on-end, grouted with bituminous composition and cement on a concrete bed.
Concrete	*Cement concrete floors* to be in the proportion of one part cement and four parts of the aggregate, to be finished with ½-in. paving of cement and sand, laid on and thoroughly incorporated with the concrete while unset, and levelled and currented as required. In the case of floors subject to considerable wear, a coating of not less than ½ in. thick of two parts granite siftings to one part cement is to take the place of the sand and cement coating.
Fire-resisting	*Solid wood* or *concrete floors*, as above described, carried by steel joists encased in concrete or by one of the various patented systems. When concrete is used there should be at least 2 in. thickness round the joists.

Other varieties of floors are occasionally used, *e.g.*, *3 in. caulked floors, double floors of deal and pitch pine or teak, slow burning floors* of hardwood on 3 in. planks with mortar between, &c.

In the case of ground floors, joists and wall plates should not be built into the walls owing to the risk of dry rot, but in other cases (except where an offset exists owing to the reduction in thickness of the wall) both the joists and the wall plates should, as a rule, be built in, in order both to save the cost of oversailing, or corbel courses, and also to tie the structure together.

The above remarks apply to ordinary bridging joists only, and not to large timbers, where free access of air is always essential.

Concrete Seal under Wood Floors.—To prevent the ground air and damp from rising within buildings, it is necessary to specially seal the surface of the ground below all ground floors of wood except in cases in which a layer of concrete forms an integral part of the flooring. This is effected by providing a layer of cement concrete about 4 in. thick (on the rammed surface of the ground or on hard filling when required), with the finished surface of the concrete *above* the ground level outside.

Currenting Floors.—Where necessary floors of stone, cement concrete, or asphalte, should be laid with a current or slope so as to shed water. The passage near an entrance should slope towards it, and passages generally should slope away from or past the doors of boarded rooms.

Ground Floors of stone or concrete should rest on not less than 4 in. of hard dry filling laid on firm ground, and the surface of the floor should be above the level of the damp course.

Herring-bone Strutting.—Where bridging joists are 8 ft. or more in length, they should have a row of herring-bone strutting to prevent twisting, and for every additional 4 ft. in the bearing, there should be an additional row of strutting.

Joists, Bridging.—Bridging joists, as a rule, are spaced 12 in. centre to centre, and should never be less than 2 in. thick.

The superimposed loads on floors may be taken as equivalent to a dead load per square foot of 1 cwt. in Officers' Quarters, Married Soldiers' Quarters and small rooms generally, 1 cwt. in Barrack Rooms, Officers' Mess Rooms and large public rooms generally. For store buildings special calculations must be made. To this must be added the weight of the floor itself and the ceiling, if any. For an ordinary planked floor and lath and plaster ceiling this may be taken at ½ cwt.

The following table of joists of Baltic Fir or Northern Pine, spaced at 12 inches centre to centre, will save repetition of calculation and gives joists of satisfactory stiffness and strength :—

Length of Bearing in Feet.	Total Dead Load Equivalent to 1 cwt.		Total Dead Load Equivalent to 1½ cwt.	
	Breadth, 2 in.	Breadth, 2½ in.	Breadth, 2 in.	Breadth, 2½ in.
	Depth in Inches.			
5	4	—	4	—
6	4½	—	5	—
7	5	—	6	—
8	6	—	6½	—
9	6½	—	7½	—
10	7½	—	8	—
11	8	7½	9	8
12	9	8½	9½	9
13	10	9	10½	10
14	10½	10	11½	10½
15	11	10½	12	11
16	12	11	13	12

Steel Joists used as Stanchions, fitted with Base Plates and Caps.

For ordinary building construction, the safe working loads for steel stanchions may be taken as in the table below :—

Properties of Sections.				Minimum Safe Load in tons.						
				Height of Stanchions in feet.						
Size in ins., A × B.	Weight per ft. in lbs.	Area in sq. ins.	Least Radius of Gyration.	8.	10.	12.	14.	16.	18.	20.
5 × 4½	17·99	5·29	1·034	19	17·3	15·4	13·7	12·2		
6 × 5	25	7·354	1·113	27·5	25	22·7	20·5	18·3		
8 × 6	35	10·29	1·32	40	37·8	35	32	29·3	26·8	24
9 × 7	58	17·06	1·647	70	67	63	59	55	51	48
10 × 6	42·02	12·358	1·362	48·6	45·6	42	39	35·5	32·5	29
10 × 8	70	20·58	1·865	86	83	79	75	71	67	63

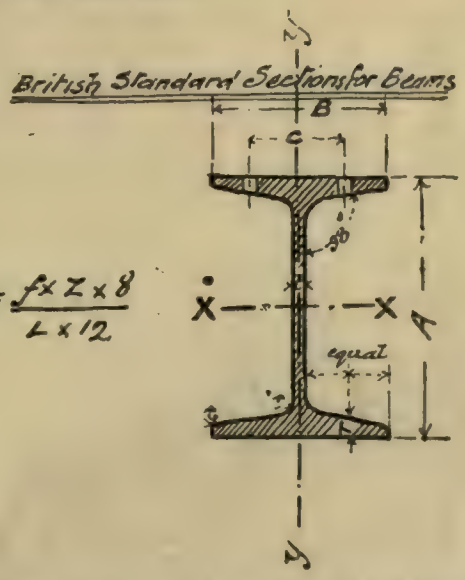
Formula for Steel Stanchions.

A = Area of section in square inches.
L = Length of stanchion in inches.
r = Least radius of gyration.
W = Maximum safe load in tons.

$$W = \frac{4{\cdot}5 \times A}{1 + \frac{L^2}{36000 \times r^2}}$$

Wall Plates—In brick walls, wall plates of fir, 4½ in. × 3 in., or of tarred and sanded wrought-iron, 2½ in. × ¼ in., should be used.

The table given below shows the sizes of joists most readily obtainable, and their safe working loads when made from 28 to 30 tons steel.



Formula for Rolled Steel Joists (distributed load only, supported both ends) :—

L = Span in feet.
f = Safe stress in tons per square inch of sectional area.
Z = Moment of Resistance.
W = Safe distributed load in tons.

$$W = \frac{f \times Z \times 8}{L \times 12}$$

NOTE.—The loads given in the tables are based on an extreme fibre stress of 7 tons per square inch, being about a quarter of the average breaking stress of 28 to 30 tons. Care should be taken, when selecting beams, that the load does not cause excessive deflection, the span should not exceed twenty times the depth except where the joists are completely cased in concrete, when the depth may safely be reduced to $\frac{1}{25}$ of span if the joist is of sufficient strength for the load. Deflection in inches for tabular loads = the square of the span in feet, multiplied by the Coefficient of Deflection which is given for each section.

Holes in flanges should be avoided if possible; if unavoidable they should be placed as at C. The loss of strength due to holes in flanges would vary from 7½ per cent. in the largest (15 in. × 6 in.) section with ¾ in. holes to 15 per cent. in the smallest (4 in. × 3 in.) section with ½ in. holes.

The limit of span, giving twenty times the depth, is indicated by the strong zig-zag line.

Size in Inches, A × B.	Weight per foot, in lbs.	Properties of Sections. (See Diagram.) Area in sq. ins.	Dimensions. Web, t.	Flange, T.	Radius, R1.	Radius, R2.	Moments of Inertia. About x...x.	About y...y.	Radius of Gyration. Inches. About x...x.	About y...y.	Moment of Resistance about x...x in tons at 1 ton per sq. in.	Centres of Holes, C. Inches.	Table of Safe Distributed Loads in tons. (Beams supported both ends.) Length of Span in feet. 2.	4.	6.	8.	10.	12.	14.	16.	18.	20.	22.	24.	Deflection Co-efficients.
15×6	59	17·34	·5	·88	·6	·3	620·09	28·2	6·02	1·275	83·87	3·5				48	39	32	27	24	21·5	19·4	17·5	16	·00125
14×6	57	16·76	·5	·87	·6	·3	533·09	27·9	5·63	1·29	76·15	3·5			57	44·5	35·5	29·5	25	22	19·5	17·7	16	14·5	·00133
12×6	54	15·87	·5	·88	·6	·3	375·59	28·28	4·86	1·33	62·6	3·5			48·5	36	29	24	20·7	18	16	14·5	13	12	·00156
12×5	32	9·4	·35	·55	·45	·22	220·11	9·74	1·83	1·01	36·68	2·75			28	21	17	14	12	10·6	9·3	8·5	7·7	7·1	·00156
10×6	42	12·35	1	·73	·5	·25	211·61	22·93	4·13	1·36	42·32	3·5			32	24	19·5	16	13·7	12	10·7	9·7	8·8	8·1	·001875
10×5	30	8·82	·36	·55	·46	·23	145·68	9·78	4·06	1·05	29·13	2·75			22·5	16·7	13·5	11	9·5	8·4	7·5	6·7	6	5·5	·001875
9×4	21	6·17	·3	·46	·4	·2	81·11	4·19	3·62	·82	18·02	2·25		20	14	10·5	8·4	7	6	5·2	4·6	4·2	3·8	3·5	·00208
8×6	35	10·29	·44	·59	·54	·27	110·59	17·92	3·27	1·32	27·64	3·5		30	21	16	12·8	10·7	9	8	7	6·4			·00234
8×4	18	5·29	·28	·40	·38	·19	55·71	3·57	3·21	·82	13·92	2·25		16	10·7	8	6·5	5·4	4·6	4	3·6	3·2			·00231
7×4	16	4·7	·25	·38	·35	·175	39·22	3·41	2·88	·85	11·2	2·25		16	8·6	6·5	5·2	4·3	3·7	3·2	2·9	2·6			·00268
6×3	12	·52	·26	·34	·36	·18	20·22	1·33	2·39	·616	6·74	1·5	13	7·7	5	3·8	3·1	2·5	2·2	1·9	1·7				·003125
5×3	11	3·23	·22	·376	·32	·16	13·62	1·46	2·05	·67	5·44	1·5	8·2	6·2	4·1	3·1	2·5	2	1·7	1·5	1·4				·00375
4×3	9·5	2·79	·22	·33	·32	·16	7·52	1·28	1·64	·677	3·76	1·5	7	4·2	2·8	2·1	1·7	1·4	1·2						·00469
4×1½	5	1·47	·17	·24	·27	·135	3·67	·190	1·57	·363	1·83	—	4	2	1·3	1	·85	·7	·6						·00469

oors—*contd.*

TABLE of Scantlings for Baltic Fir or Northern Pine Floor Joists (spaced 12 inches centre to centre) for an ordinary load, equivalent to a dead load of 140 lbs. per sup. ft., including the weight of the floor and plaster ceiling.

Breadth in Inches.	2	2¼	2½	2¾	3
Length of Bearing in Feet.	Depth in Inches.				
5	4½	4	3⅞	3⅝	3⅜
6	5	4¾	4½	4¼	4
7	5⅞	5½	5¼	5	5
8	6¾	6¼	6	6	5¾
9	7½	7	6¾	6⅝	6½
10	8¼	8	7½	7½	7½
11	9	8¾	8¼	8	8
12	9¾	9½	9	8⅞	8½
13	10½	10¼	9¾	9½	9¼
14	11¼	11	10½	10¼	10
15	12¼	11¾	11¼	11	10¾
16	13	12½	12	11⅞	11½

Joists, Steel.—For larger spans, composite floors with wood bridging joists and steel main joists will usually be employed.

Joists, Trimmer.—For ordinary trimming of single floors at hearths, &c., trimming joists may be taken as bridging joists, with the addition of ⅛ in. in thickness for every joist the trimmer has to carry. In such cases the trimmer may be of the same scantling as the bridging joists, provided it does not carry more than three of them, but ¼ in. must be added to its thickness for each joist carried beyond three.

In floors where the bridging joists run parallel to the chimney breast, the thickness of the trimming joist must be greater by ¾ in. for every joist trimmed, the trimmer and the trimmed joists being of the same scantling as the bridging joists.

When the trimmed opening is large, or comes near the centre of a floor (*e.g.*, for lifts, &c.), the scantlings of trimmers and trimming joists should be specially calculated.

Junction of Wood and Stone Floors.—The junction of wood and stone or concrete floors should be carefully made water-tight. This can be done with angle-irons bedded in white lead and screwed to the floor boards and to lead plugs in the stone or concrete.

Non-absorbent Flooring.—Where specified, should be made non-absorbent by being treated with a mixture of paraffin and wax, well rubbed in.

Sound pugging.—Sound pugging is not ordinarily required in barrack buildings. When provided, it should be of coarse stuff, about 2 in. thick, roughly floated, and carried on ¾-in. boarding fixed between joists to fillets nailed to their sides.

Upper Floors of concrete, whether resting on walls or corbelling, or carried by wrought iron or steel joists, should have their supports not more than 3 ft. apart, unless reinforced concrete is used; and in order to avoid cracks, the floors should be laid in slabs not larger than 12 ft. by 10 ft., with ¼-in. wood fillets between abutting edges, which should always be supported. When the concrete has set, the fillets are removed, the chase left being filled in with fine concrete or cement.

Ventilation of Floors.—Air bricks should be provided at frequent intervals for the free ventilation of joists supporting ground floors, the surface of which floors should be kept at least 12 in. above the ground outside. When there are partition or sleeper walls, care must be taken that the air bricks are so placed as to ensure thorough *through* ventilation of the whole of the space below the floors, openings being left for this purpose, if necessary, in the partition walls. Strong cast iron gratings are preferable to thin perforated bricks, which are liable to get broken. Provision may also sometimes be desirable for the ventilation of upper floors.

ings and dations.

It is of primary importance that the walls of a building should be carried on foundations that will ensure uniform settlement; with this object, the bearing surfaces must be calculated so that a practically uniform load is borne by the ground under all parts of the building; in cases where high chimneys or towers are built adjacent to lower buildings, the foundation and masonry of the heavier structure should be kept quite separate, so that the greater amount of settlement will not affect the walls of the abutting buildings.

Made ground should never be trusted; the subsoil should in all cases be examined by trial pits, and in treacherous ground trenches may have to be dug before the foundations are designed.

The safe loads that may be allowed in tons per sq. ft. are as follows. These should not, however, be accepted as reliable in every case:—

Soft chalk or loam	1
Compact sand and ordinary clay	2
Hard white chalk and stiff clay	3
Gravel	4

The foundations must be taken deep enough to be unaffected by frost; in Great Britain foundations in clay will usually be safe if the trenches are dug 4 ft. deep; in other kinds of earth subsoils, 3 ft. may be sufficient.

Surface or subsoil water should be drained away from any proposed foundations.

In W.D. practice it is usual, in the case of ordinary buildings, to save the expense of footings and build direct on the concrete bed, which is, in common practice, brought up to within 6 in. of the finished ground line.

Where this will bring a load of over ⅝ tons per sq. ft. on the concrete, it is advisable to widen the wall at its base by footings. Footings will usually be built with a half-brick reduction in every second course, and under footings the depth of concrete will usually be a third its width, and in no case less than 9 in., and the concrete must project at least 4 in. on each side of the lowest course of footings. The width of the concrete being calculated in all cases with reference to the safe load on the ground and even distribution of the load under all parts of the building.

For further information, see S.M.E. Notes on Foundations.

rs.

Larders should, if possible, face the North; the East being the next best aspect.

The windows should be barred, and any window which does not face the North, or nearly so, should be protected from the sun by jalousied shutters or blinds.

Earth Closets.—When it is necessary to use earth closets, the apparatus should take the form of a simple plank seat laid on bearers, from which it can be lifted and scrubbed daily. A pail, a little larger in diameter than the hole, is provided to fit closely below the seat; also a box for dry earth and a scoop. Automatic mechanical contrivances for depositing the earth are very apt to get out of order and should be avoided. It is essential that the earth to be used in earth closets should be dry and thoroughly pulverized.

Larders—*contd.*

The floors should be of concrete or stone, and the walls may be lined 7 ft. high with white glazed bricks or tiles of second quality, and be limewhited above that level. Ceilings plastered and limewhited.

Ventilation.—Louvred ventilators are not required. Fresh air should be admitted near the floor line by a duct, or ducts, straight through the wall, with air bricks or hinged iron gratings at the outer end and galvanised fly wire at the inner end. Similar openings should be provided in the upper part of the walls, or the upper panes of the windows may be filled with fly wire instead of being glazed.

Latrines, W.C.s and Urinals.

Earth Closets. The hopper arrangement often provided in Earth Closets is very apt to get out of order, especially if the earth is not properly dried. For this reason it will frequently be found better to omit it altogether and to substitute a simple box and scoop.

Latrines.—Where Latrines are used they should be of the continuous pipe pattern, with syphonic discharge; trough Latrines should not be used; separately flushed Water Closets are now, however, generally adopted in all new work.

Urinals.—Urinal stalls are usually made 24 in. wide from centre to centre. Indoor urinals should be of glazed stoneware or porcelain, and should be trapped as close to the urinal as possible.

Water Closets.—For outside Water Closets the normal size in the clear should be 2 ft. 6 in. by 4 ft. when the door opens outwards, and 2 ft. 6 in. by 4 ft. 9 in. when the door opens inwards. Doors 2 ft. 1 in. wide are suitable in either case.

The normal dimensions for all inside Water Closets are 3 ft. wide by 5 ft. long. The doors should be 2 ft. 3 in. wide, and hung to open inwards.

Exigencies of plan may, in certain cases, lead to a modification of the above dimensions, but, as a rule, they should be adhered to as nearly as possible.

In the case of internal Water Closets having tile or wood floors, sheet lead should be fixed under the apparatus. All other internal Water Closets, and all outdoor Water Closets, in Yards, &c., should have concrete floors.

The proper heights for the seats are—for adults, 1 ft. 6 in.; for children, 1 ft. 2 in. The provision of a 4-in. step may sometimes be a convenient method of converting an adults' Water Closet to dual use.

Water Closet apparatus should be of the "wash-down" description, with a hinged flap seat, and it should not be boxed in. It should, as a rule, be placed against the outer wall of the compartment.

The flushing cistern should be of a kind which, when set in action, will continue running until the whole contents shall have been discharged, the minimum flush allowed being 2 gallons, and the cistern is usually fixed 4 ft. above the apparatus.

Water Closets, Ventilation of.—All indoor Water Closets should be properly ventilated, with means of closing both inlets and outlets in case of severe frost. Outdoor Water Closets can be ventilated by keeping the bottom edge of the door a few inches from the floor, and leaving a space also between the top of door and frame over.

For further information see "Drainage Manual."

Paving.

Paved Paths.—Paved paths should be of cement concrete, 4 in. thick, finished with granite siftings, with chamfered curbs and surface channels as required, formed in concrete or of cement concrete blocks laid on concrete. When exposed to exceptional wear or heavy traffic the curbs may be of stone, not less than 4 in. thick, and the channels of stone or pitcher paving. The paving should be laid on 4 in. of hard filling, the ground, if soft, being first well rammed. In exceptionally firm ground the hard filling may sometimes be omitted.

When laying concrete for paths, floors, &c., it is usual to lay out the area in bays; screeds (i.e., deal fillets) are first laid and levelled, alternate bays are then filled in with concrete, and, when set, the screeds are removed and the other bays filled in.

Footpaths along buildings should slope away from them at a slope of 2 in. in 10 ft., and other footpaths should be barrelled to a similar extent.

Yards should be currented to gullies, and when not gravelled or paved with pitchers, should be paved in a similar manner with cement concrete.

When stone flagging, curbing, &c., is cheaper than cement concrete, it can be used instead.

Footpaths may also be formed of tar pavement, or of 3 in. of clean hard stone siftings, the size of a hazel nut, well rolled and grouted with cement.

Pavement round Buildings.—In exceptionally wet soils buildings intended for habitation should be bordered with similar cement concrete paving 3 ft. or 4 ft. wide on all sides where paved footpaths are not provided for traffic. As far as possible all underground drains should be kept outside this pavement, and surface channels should be formed, when required, on its outer margin.

Pitcher Paving.—Pitcher paving, being expensive, should only be provided for heavy or constant traffic. It should be formed of pitchers 5 in. or 6 in. deep, laid on cement concrete 4 in. thick. The ground, if soft, should first be well rammed and covered with hard filling 6 in. thick. Any gutters in connection with pitcher paving and exposed to heavy traffic should also be of pitchers, or of a stone channel course.

Surface Channels.—Surface channels should be of cement concrete formed *in situ* or made in blocks, laid on hard filling, or of hard bricks on edge laid on 5-in. cement concrete, except when exposed to much or heavy wheeled traffic, in which case stone channel courses or stone pitchers on cement concrete should be used.

Surface channels should be kept away from the walls of buildings; they are often used to take rain-water so as to reduce the number of gullies.

Roads and Parades.

Parades.—The site should be excavated to the depth necessary to receive the finished thickness of metal or gravel when consolidated.

Such "filling-in" as may be found necessary should be *well* rammed or rolled, water being added to assist consolidation.

Before laying the metal or gravel, the surface of the excavation should be formed or graded to the required falls, to correspond with the proposed finished surface of the parade, all thicknesses given below being intended to refer to the thickness after consolidation.

Foot Parades should then be formed of 4 in. of hard filling and 3 in. of screened gravel; "hogging," or fine stuff for binding being added as required.

Parades for mounted troops should be formed of 4 in. of hard filling, and 4 in. of hard stone broken to a 1½-in. gauge, with sufficient fine screened gravel to fill the interstices.

The surface should be currented to the surface channels and well rolled with a steam-roller.

Local materials should be used as much as possible so as to keep down cost. In a clay country, burnt clay ballast will do both for hard filling and gravelling. In stone countries, quarry siftings and chippings will answer for gravel. In iron countries, forge and furnace ashes and clinkers are available, and in chalk countries, flints. Shales and clay slates are of little use. Chalk will do as a foundation for hard filling, and if powdered and well mixed with shingle, it will, if watered, roll into a fair parade.

Paths.—Paths may be formed like Foot Parades or may be paved.

Roads and Parades—*contd.*

Roads for Light Traffic.—Most of the roadways in a Barrack may be formed in the same manner as Parades for mounted troops (see above), except that 6 in. of hard filling is necessary, unless the ground is exceptionally well consolidated.

But it is essential that the metalling for roads should be of hard stone that will stand wear and weather.

Roads for Heavy Traffic.—The surface to be metalled should be well consolidated with a 10-ton steam roller, and shaped parallel to, but 6 in. lower than, the surface line of the finished road. The sides should fall 1 in 12 to the gutters, the centre 6 ft. of road being formed to a curve of 90 ft. radius.

The foundation should be of bricks, or stones with flat bases, hand-packed, 6 in. thick, or of 6 in. of concrete, whichever is least costly.

The metal should be of the hardest and toughest stone available, broken to a 2½-in. gauge; it should after consolidation be 6 in. thick for main roads and 4 in. thick for branch roads, and coated with fine screened gravel sufficient to fill the interstices. The surface should be well watered and rolled with a 10-ton steam roller, gravel being added during the final part of the process till all joints are closed and the roller makes no further impression.

Few roads of this description are required for Barracks, but the main road construction might be used at the entrances, and the branch road construction for the principal thoroughfare of a Barrack or for roads leading to Gun and Wagon Sheds and Forage Barns.

If drain, gas or water pipes are laid along the lines of new roads, care should be exercised in the employment of a heavy steam roller, and to avoid injury from traction engines it is advisable to lay them along one side of the road rather than in the middle.

Trees and Grass.—In every Barrack, trees of kinds known to flourish in the locality should be planted round the Parade or along the roads and in different parts where they will look well or act as a screen from dust or shelter from wind, and not cause inconvenience or obstruct light and vetilation. They should be planted in holes prepared and manured for them, and should be protected from injury.

All surfaces not much exposed to traffic should be laid down in grass, as being less costly than gravelling, less dusty, and entailing less labour on the troops for keeping in order.

Roofs.

In order to combine efficiency with economy the following points should be borne in mind, viz.:—

i. Long spans should be avoided, as necessitating heavy scantlings and thick walls.
ii. Trusses should be introduced for spans over 18 ft., unless cross walls can be utilised to carry the purlins.
iii. The "pitch" should not be excessive. A low pitch not only reduces the amount of timber and roof covering and thus lessens the weight of roof itself, but also offers less resistance to the wind. Thus smaller scantlings can be used.
iv. The roof plan should be as simple as possible, so as to reduce the number of hips and valleys to a minimum consistent with appearance, and avoid the expense of cutting into the roof.
v. Standard or "trade" scantlings should whenever possible be adopted; this applies particularly to iron roofs.
vi. To avoid risk of snow, &c., lodging, horizontal valley gutters and parapets, except to gables, should be avoided.

Pitch.—Roofs are ordinarily made at the following slopes. Flatter slopes should not be adopted without due consideration of all the circumstances of the particular case. Steep slopes are necessary in localities where much snow may be expected. The roofs of different portions of the same building should, as a rule, be uniform in pitch and, if only for appearance sake, it is generally desirable to adopt the same pitch and roof covering for neighbouring buildings of similar character.

Roof Covering.	Angle with Horizon.	Ratio of Rise to Span, *i.e.*, Pitch.	Remarks.
	° ′		
Zinc and lead	3 50	1/30	
Corrugated iron ..	7 36	1/15	Corrugated iron is very apt to corrode when used near the sea. Hips and valleys should be avoided when it is to be used.
Asphalted	18 26	1/3	
Ordinary slates	26 33	1/2	In sheltered situations only.
	29 41	5/8	In ordinary situations.
	33 41	2/3	In exposed situations.
Plain tiles	45 0	1	

Eaves, Eaves Gutters and Down Pipes.—As a rule eaves should project not less than from 8 in. to 12 in. over the walls; this protects the walls somewhat from rain, generally looks better, and allows any ventilating pipes to be run straight up the wall behind the eaves gutter instead of stopping it or being bent round it. With solid walls the importance of having projecting eaves is greater than with hollow walls.

The heaviest rainfall on an area of 400 sq. ft. can be dealt with by an unobstructed 3½-in. eaves gutter through one outlet, while a 4-in. gutter will deal with 750 sq. ft. per outlet, a 4½-in. gutter with 1,100 sq. ft., and a 5-in. gutter with 1,500 sq. ft. For eaves gutters of these widths down pipes of 1 in. less diameter would suffice; it is not desirable to place down pipes more than 50 or 60 ft. apart. A down pipe of greater diameter than 4 in. would seldom be required, except for large lead gutters or flats.

Down pipes should, wherever possible, be placed near the middle of the length of eaves guttering which they serve. They should be fixed 1½ in. clear of the wall, so as to avoid soaking it should they leak, and to give room for painting them.

They should discharge over a surface channel or gully, except in cases where the rain-water is to be stored. In cases where gratings are likely to become choked with leaves, &c., it may be advisable to arrange for the down pipe to discharge below them. Special gullies are made for this purpose.

Hopper heads should always have perforated covers of cast-iron, or copper wire caps.

Half-round eaves gutters are better than moulded ones, as, owing to the mode of fixing them, less damage is caused by any overflow. For the sake of appearance, however, moulded gutters fixed to fascia boards clear of all brickwork or masonry are generally used for the more important and conspicuous buildings.

The inner edge of such gutters should be fixed a little higher than the outer edge, and it is desirable to have a rib or fillet cast on the soffit of the gutter, so as to form a drip.

In order to make certain that there is no slope the wrong way, it is as well to give every length of eaves gutter a *very slight* fall towards the down pipe serving it.

Flats, Gutters, Flashings, Valleys, &c.—In the best work, and in all important buildngs, these should be of lead; but when lightness or economy are of the first importance, zinc, if properly laid and fixed

Roofs—*contd.*

without nails or solder, may be substituted, except where liable to be exposed to the action of chemical fumes in large manufacturing towns. The use of zinc should also be avoided in situations readily accessible to cats, or in immediate contact with other metals, *e.g.*, iron, lead, copper, or with lime, or with woods containing acids, such as oak, cedar, &c.

Lead in gutters and flats should be 7 lbs. per foot super., laid with a fall of not less than 1 in. in 10 ft., the edges turned up 6 in. against the walls, 9 in. under slates, with 5 in. laps and 2 in. drips.

Lead flashings, hips and ridges should be of 5 lbs. lead, laid with 3-in. lap.

Lead valleys should be of 6 lbs. lead, with 4-in. laps and 22 in. wide, to allow for 9 in. under the slates on both sides.

Zinc, if used in flats, gutters, flashings, &c., should be specified of the best quality, 15 or 16 gauge, the former for flats, the latter for gutters. When it is proposed to be largely used, a special contract should be entered into with approved firms, from whom a guarantee of durability should be obtained. The life of zinc may be increased by the application of two coats of paint every four years, but the first painting should not be done sooner than about a year after the zinc is laid.

Slates, ~~except in special cases~~, should be ~~Countess~~, laid to a 3-in. lap on 1-in. boarding. Felt should be placed under slates in open roofs to buildings where the noise of heavy rain would be objectionable, or where it is desirable to guard against rapid changes of temperature.

Ventilation of Roof Space.—Means of ventilation to each section of the roof space should always be provided, and it is desirable that they should be such as to admit a certain amount of light as well a air, especially in cases where cisterns are placed in the roof.

Roof Scantlings, Wood.

Common Rafters are usually spaced 12 in. apart in the clear.

Hips, Ridges, and Valley Rafters.—Hips and ridges should, as a rule, be 1½ in. thick, and of sufficient depth to take the common rafters; valley rafters, if unsupported, should be of somewhat greater thickness.

Trimming Rafters and Trimmers.—The rule of thumb for these is as follows, viz.:—

The scantlings of trimming rafters should be those of the common rafters increased by ½ in. in thickness for every rafter trimmed; or the trimming rafters may instead be increased in depth: the trimmers are usually made of the same scantlings as the trimming rafters.

Purlins.—A good proportion for scantlings is obtained by making $b : d :: 2 : 3$. Trussed or strutted purlins are often economical.

Wall Plates are ordinarily made 4½ in. by 3 in., so as to work in with the brick courses.

Tables of Scantlings.—Subject to the foregoing remarks, the following Tables give the scantlings for wooden roofs of different spans and pitches when constructed of Northern Pine or Baltic Fir.

When timber of other descriptions is used, or when the spacing is different, the scantlings must be calculated.

These tables are intended as a rough and ready practical guide to the selection of convenient scantlings, and the dimensions given must not be looked upon as representing theoretically safe minima. The aim has been:—

(i) To avoid small scantlings which cannot, in practice, be spiked or halved without danger of splitting.

(ii) To avoid stating dimensions with greater accuracy than is practically obtainable in ordinary carpenters' work.

(iii) To follow trade scantlings as far as possible.

Trusses at varying intervals.—The rule of thumb for applying the tables when the distance apart, centre to centre, is more or less than 10 ft., is:—

Multiply the distance apart by the span and divide the product by 10.

The result will give the span of truss in table, the scantlings of which should be applied to the given span.

Example—Span 21 ft., and distance apart 12 ft.: $\frac{21 \times 12}{10} = 25{\cdot}2$.

The scantlings should therefore be those given in the tables for a truss of 25 ft. span.

TABLE No. 1.

CLOSE-COUPLE ROOF SCANTLINGS

of Northern Pine or Baltic Fir.

With Ceilings;—Roof Covering, Countess Slates on 1-in. boarding;—Pitch up to ⅔ (= say 30°).

Span of Roof.	Rafters (12 in. apart in the clear).	Ridge Board.	Ceiling Joist.	Span of Roof.	Rafters (12 in. apart in the clear).	Ridge Board.	Ceiling Joist.
Ft.	Depth. Breadth. In.	Depth. Breadth. In.	Depth. Breadth. In.	Ft.	Depth. Breadth. In.	Depth. Breadth. In.	Depth. Breadth. In.
8	4 × 2	7 × 1½	4 × 2	14	4½ × 2	9 × 1½	7 × 2
10	4 × 2	7 × 1½	5 × 2	16	5 × 2	9 × 1½	8 × 2
12	4 × 2	7 × 1½	6 × 2	18	6 × 2	9 × 1½	9 × 2

Roof Scantlings, Wood—*contd.*

TABLE No. 2.

COLLAR-TIE ROOF SCANTLINGS

of Northern Pine or Baltic Fir.

With and without Ceilings;—Roof Covering, Countess Slates on 1-in. boarding;—

Pitch up to $\frac{1}{3}$ (= say 35°).

Span of Roof.	Rafters (12 in. apart in the clear).	Collars.*				Ridge Board.
		Half-way up.		Quarter-way up.		
		No Ceiling.	Ceiled to Collars.	No Ceiling.	Ceiled to Collars.	
	Depth. Breadth.	Depth. Breadth.	Depth. Breadth.	Depth. Breadth.	Depth. Breadth.	Depth. Breadth.
Ft.	In.	In.	In.	In.	In.	In.
8	4 × 2	4 × 2	4 × 2	4 × 2	4 × 2	7 × 1½
10	4 × 2	4 × 2	4 × 2	4 × 2	4 × 2	7 × 1½
12	4 × 2	4 × 2	4 × 2	4 × 2	4½ × 2	7 × 1½
14	4½ × 2	4 × 2	4 × 2	4 × 2	5 × 2	9 × 1½
16	5 × 2	4 × 2	4 × 2	4½ × 2	6 × 2	9 × 1½
18	6 × 2	4 × 2	4½ × 2	4½ × 2	7 × 2	9 × 1½

* A rough-and-ready rule of thumb for obtaining the scantlings of collars *at any height* is as follows, viz.: width, 2 in.; depth, ½ in. for every foot run of clear length of under side of collar. The scantlings thus obtained will suffice to take ordinary ceilings.

As above, but Roof Covering, Plain Tiles on 1-in. boarding;—Pitch ½ (= 45°).

8	4 × 2	4 × 2	4 × 2	4 × 2	4 × 2	7 × 1½
10	4 × 2	4 × 2	4 × 2	4 × 2	4 × 2	7 × 1½
12	5 × 2	4 × 2	4 × 2	4 × 2	4½ × 2	9 × 1½
14	5 × 3	4 × 2	4 × 2	4 × 2	5 × 2	9 × 1½
16	6 × 2½	4 × 2	4 × 2	4½ × 2	6 × 2	9 × 1½
18	6 × 2½	4 × 2	4½ × 2	4½ × 2	7 × 2	9 × 1½

Roof Scantlings, Wood—*contd.*

TABLE No. 3.

KING-POST ROOF SCANTLINGS

of Northern Pine or Baltic Fir.

Trusses 10 ft. apart, centre to centre.*

With and without Ceilings;—Roof Covering, Countess Slates on 1-in. boarding;—Pitch up to $\frac{1}{3}$ (= say 35°).

Span of Roof.	Tie Beam. Without Ceiling. Depth.	Tie Beam. Without Ceiling. Breadth.	Tie Beam. With Ceiling. Depth.	Tie Beam. With Ceiling. Breadth.	Principal Rafters. Depth.	Principal Rafters. Breadth.	King Post. Breadth.	King Post. Thickness.	Struts. Breadth.	Struts. Thickness.	Purlins. Depth.	Purlins. Breadth.	Common Rafters 1 ft. apart in the clear. Depth.	Common Rafters 1 ft. apart in the clear. Breadth.	Ridge. Depth.	Ridge. Breadth.	W.I. Bolts (at joints of truss). Diameter.	W.I. Straps Breadth.	W.I. Straps Thickness.
Ft.	In.		In.		In.		In.		In.		In.		In.		In.		In.	In.	
18	5	4	9	4	4	4	4	3	3	3	8	4	4	2	7	$1\frac{1}{2}$			
19	5	4	9	4	4	4	4	3	3	3	8	4	4	2	7	$1\frac{1}{2}$			
20	5	4	9	4	4	4	4	3	3	3	8	4	4	2	7	$1\frac{1}{2}$			
21	6	4	9	$4\frac{1}{2}$	4	4	4	3	4	3	8	5	4	2	7	$1\frac{1}{2}$			
22	6	4	9	5	5	4	4	4	4	3	8	5	4	2	7	$1\frac{1}{2}$			
23	6	4	9	5	5	4	4	4	4	3	8	5	4	2	7	$1\frac{1}{2}$			
24	6	4	10	5	5	4	5	4	4	3	8	5	4	2	7	$1\frac{1}{2}$	$\frac{1}{2}$	2	$\frac{1}{4}$
25	7	4	10	5	5	4	5	4	5	3	8	5	4	2	7	$1\frac{1}{2}$			
26	7	4	10	5	5	4	5	4	5	3	8	5	4	2	7	$1\frac{1}{2}$			
27	7	4	11	5	5	4	5	4	5	3	8	5	$4\frac{1}{2}$	2	9	$1\frac{1}{2}$			
28	7	4	11	5	6	4	5	5	5	3	9	5	$4\frac{1}{2}$	2	9	$1\frac{1}{2}$			
29	7	4	11	6	6	4	5	5	5	3	9	5	$4\frac{1}{2}$	2	9	$1\frac{1}{2}$			
30	7	4	11	6	6	4	5	5	5	3	9	5	5	2	9	$1\frac{1}{2}$			

* See also "*Trusses at varying intervals*" above.

With and without Ceilings;—Roof Covering, Plain Tiles on 1-in. boarding;—Pitch $\frac{1}{2}$ (= 45°).

18	5	4	9	4	7	4	5	4	3	3	9	5	4	2	7	$1\frac{1}{2}$			
19	5	4	9	4	7	4	5	4	3	3	9	5	4	2	7	$1\frac{1}{2}$			
20	5	4	9	4	7	4	5	4	3	3	9	5	4	2	7	$1\frac{1}{2}$			
21	6	4	9	5	7	4	5	4	4	3	9	5	4	2	7	$1\frac{1}{2}$			
22	6	4	9	5	7	5	5	5	4	3	9	6	4	2	7	$1\frac{1}{2}$			
23	6	4	10	5	7	5	5	5	4	3	9	6	4	2	7	$1\frac{1}{2}$			
24	6	4	10	5	7	5	5	5	4	3	9	6	4	2	7	$1\frac{1}{2}$	$\frac{5}{8}$	2	$\frac{1}{4}$
25	7	4	10	5	7	5	5	5	5	3	9	6	5	3	9	$1\frac{1}{2}$			
26	7	4	11	5	8	5	5	5	5	3	9	7	5	3	9	$1\frac{1}{2}$			
27	7	4	11	5	8	5	5	5	5	3	9	7	5	3	9	$1\frac{1}{2}$			
28	7	4	11	6	9	5	6	6	5	3	9	7	5	3	9	$1\frac{1}{2}$			
29	7	4	11	6	9	5	6	6	5	3	9	7	5	3	9	$1\frac{1}{2}$			
30	7	4	11	6	9	6	6	6	5	3	9	7	5	3	9	$1\frac{1}{2}$			

TABLE No. 4.

PURLINS†

of Northern Pine or Baltic Fir.

Roof Covering—Countess Slates on 1-in. boarding.

Bearing in Feet.	Distance apart in Feet, measured along slope of Roof. 6 Depth.	6 Breadth.	7 Depth.	7 Breadth.	8 Depth.	8 Breadth.	9 Depth.	9 Breadth.
Ft.	In.		In.		In.		In.	
6	6	3	6	3	6	4	6	4
7	6	4	6	4	7	4	7	5
8	7	4	7	4	8	5	8	5
9	8	5	8	5	9	5	9	5
10	8	5	8	5	9	5	9	5
11	8	5	9	5	9	5	9	6
12	9	5	9	5	9	6	9	6
As above but,—Roof covering.—Plain tiles on 1-in. boarding.								
6	6	4	6	4	7	4	8	4
7	7	4	7	4	8	5	8	5
8	8	5	8	5	9	5	9	5
9	9	5	9	5	9	6	9	6
10	9	5	9	5	9	6	9	6
11	9	5	9	6	9	7	9	7
12	9	6	9	6	9	7	9	8

† *Purlins should run clear of chimney stacks. When resting on cross walls it is usually advisable to strut the longer spans so as to make the unsupported lengths of all the purlins as nearly as possible equal A span of* 10 *or* 11 *feet is usually the most economical. There is a gain of strength and stiffness if the purlins are long enough to rest on* 3 *trusses, but in view of possible cutting during repairs it is undesirable to reduce the scantlings on account of this.*

Sinks.

Sinks should, as a rule, be fixed with the top at a height of 2 ft. 2 in. or 2 ft. 3 in. above the floor line, and should be from 5 in. to 8 in. in depth, 6 in. being a good average. There should be 15 in. clear between the bottom of sink and the tap. The grating in sink should be of brass, 3½ in. diameter at the least, secured to an approved galvanised iron trap with a brass cleaning screw fixed close under the sink with a 2 in. waste pipe discharging in the open air over a hopper head or trapped gully. If there is a metal plug to the waste, it should be secured by a chain. It is best to arrange for the discharge to be immediately *below* the grating of the gully, so as to avoid choking the grating, and thus causing an overflow.

Pantry Sinks and the like should be of wood, lined with lead.

Scullery and Kitchen Sinks should be of glazed stoneware, unless otherwise specified.

Stairs and Steps.

The vertical height from the treads (at the nosings) to the upper surface of the handrail should, ordinarily, be 2 ft. 8 in.; this height should be slightly greater over winders, and at landings it should be increased to about 3 ft.

Flights, &c.—It is not desirable to have more than 12 or 14 steps without a landing. Winders at the head of a long flight are inadmissible.

The head-room of staircases should be 6 ft. 9 in. at least, measured from the edges of the treads, and a greater height is desirable. The landings should have, at least, as much head-room as the stairs.

Materials.—Except in the case of self-contained quarters, internal stairs should generally be of stone or iron, with landings of stone or cement concrete. Approved patent treads may be adopted, especially where there is much traffic. Stone treads should be of hard, good-wearing stone, not likely to become dangerously slippery.

Wooden staircases should not be used where they would be a probable source of danger to life in case of fire; this applies especially in the case of emergency staircases, intended only for use in the case of fire.

External staircases may be of stone or of iron. The treads in the latter case may be of roughened open-work barfed iron, of teak, or of some approved patent form.

Treads and Risers.—No tread should be less than 8 in. and no riser higher than 8 in. at the outside, the nosing, if any, being in addition to the tread given.

A good proportion between tread and riser will be obtained if the width of the tread, added to twice the height of the riser, is equal to 24 in.: thus, with treads of 8, 9, 10, 11 and 12 in. respectively the risers will be 8, 7½, 7, 6½ and 6 in.

The treads of winders should not be of less width at the centre than the straight treads.

Verandahs.

The floors of verandahs should generally be of cement concrete, currented at a slope of 2 in. in 10 ft., so as to shed the water away from the walls, and there should be a 6-in. chamfered cement skirting along the wall. In front of doorways where there is much traffic, the surface of the concrete may be finished with fine granite chippings.

Ground floor verandah columns should, as a rule, rest on base stones rising about 6 in. above the floor.

Verandah railings should, as a rule, be 3 ft. 6 in. in height.

Verandah roofs may, when desirable, be glazed, either wholly or in part.

Walls.

Arches and Lintels.—All arches in walls should be built in cement and sand.

External arches over doors and windows should, as a rule, be segmental, with a rise of 1 in. per ft. of span. Semi-circular arches may also be used, especially in the case of doors. Flat arches and gauged work generally should be avoided as much as possible.

Internal arches should, in the case of internal walls, be the full thickness of the wall, and, in the case of external walls, the full thickness of the wall less the width of the external arch or head. They should be in half-brick rings, with proper skew-backs. Similar arches should be turned over all lintels, care being taken that they spring clear beyond the ends of the lintels, if these are of wood.

Wood Lintels should be dispensed with as far as possible; when used they should have a depth of about 1 in per ft. of span of opening.

Boundary Wall or Fence.—When a boundary to the Barracks is required, it may be a wrought iron or steel railing 5 ft. 6 in. high, on coped wall 1 ft. 6 in. high; a wall 7 ft. high coped with glass; or a railing 7 ft. high, according to circumstances.

Damp Course.—All walls of buildings should have a damp course.

In the case of buildings intended for occupation, the damp course should consist of a ¾-in. layer of asphalte, but for yard or shed-walls a damp course of two courses of slate in cement would suffice.

When much stepping of the damp course is required, or when skilled labour is not available, it may sometimes be found better to use 3-lb. sheet lead instead of asphalte; but this is only admissible when building in cement, as lime mortar eats away the lead.

The best level for the damp course is from 6 to 9 in. above the finished level of the surrounding ground, but in buildings intended for occupation it should butt on the inside against the concrete of the floor in the case of solid floors; and in the case of wooden floors with an air space below, it should be below the under side of the wall plate. Hence it is often convenient in the case of hollow walls to have the damp courses of the inner and outer skins at different levels.

Hollow Brick Walls.—These will generally be found somewhat more expensive than solid walls; they require more care in construction, and there is some risk of the thin outer skin being damaged by the scaffolding; they are, moreover, neither so strong nor likely to be so lasting as solid walls. On the other hand, they are undoubtedly warmer and more damp-proof. They are, therefore, necessary in exposed positions, except when walls containing 18 in. of good brickwork are required, in which case a hollow space (except for ventilation, as in Magazines) is superfluous.

They are only suitable for buildings not exceeding 3 stories in height at the most, and they should not be used for Stables. In all other cases local experience and local considerations should be carefully taken into account before deciding whether to use hollow or solid walls.

Hollow brick walls should consist of a 4½-in. skin of brickwork on the outside; then a 2½-in. air space, and inside that, the main body of the wall, which should be of the thickness required by constructional rules for solid walls. The outer skin should be securely tied to the inner wall. To prevent the moisture from the outer skin being transmitted to the inner wall, the hollow space should be carried down at least 1 ft. below the damp-proof course, and means provided for carrying off the water. It should cease about 1 ft. below the eaves, above which level the wall should become solid. No communication should be made between the top of the hollow space and the outer air. The hollow space must be kept free from mortar and rubbish by approved means.

The air space should be carried round all angles, and up to the sides of all window frames, with no points of communication between the exterior and interior walls, except such as are formed by the bonding bricks, by the solid portions of walls next to the door frames, or by ventilating ducts, which should be carried across the air space in glazed pipes or in boxings formed of roofing slates jointed in cement, or of some other material which will not conduct moisture. Care should be taken that the bridge thus formed should have, if possible, a slight fall outwards. To prevent the inflow of water by means of the break in the air space caused by door and window heads, a strip of 4-lb. lead should be built

Walls—*contd.*

into the outer skin of the wall over each discharging arch or lintel, the lead to be 4½ in. wide, 2 in. being built into the wall, and 1½ in. projecting into the air space, with the inside edge slightly turned up; and it should be carried 2 in. beyond the frames each way, so as to throw the water clear of them.

Hollow brick walls should not be used, without special precautions, on the top of solid walls, or in any part of a building where they would be external walls in their upper part and party walls to annexes below, because the outer skin, which may become saturated, would conduct moisture to the solid wall or show damp in the rooms built against it. In these cases it would be best to build the wall solid throughout, of sufficient thickness to be damp proof.

If this cannot be done the special precautions would have to be of the nature of a damp course (which might be of asphalte) covering the bottom of the hollow and the foundation of the outer skin, and turned up as a skirting 6 in. high against the face of the inner skin.

Hollow walls are sometimes advisable for internal walls when it is necessary to make special provision to deaden sound; *e.g.*, when a noisy workshop is next to an office.

Internal Walls.—The arrises of all plastered walls should be rounded off in half cement and half sand 4 in. girth, and, in case of unplastered walls, should be finished with bull-nosed bricks.

As it is difficult to obtain a large number of bricks of equal length, 9 in. brick walls not intended to be plastered should, as a rule, be built with three courses of stretchers to one course of headers; all headers to be gauged to a uniform length.

Jointing of External Faces of Brick Walls.—The outer face of external walls built in brickwork should be finished with a neat struck weather joint.

Partition Walls.—These will rarely exceed 9 in. in thickness. They will more usually be of 4½-in. brickwork built in sand and cement (1 to 3) and with door jambs strengthened by piers, or a partition of any approved kind may be used. The nature of the partition to be used in any particular case will depend on the character and finish of the adjoining walls. Unless required to support the roof, partitions should not extend above the level of the ceiling joists. (This does not apply to *party walls*. *See* below.)

Party Walls.—To reduce the risk of fire, party walls in long blocks containing independent premises, should, at intervals, run straight across the block, and be carried up 18 in. above the roof covering. They should also be corbelled out, front and rear, at the level of the eaves, to break the continuity of the fascia boarding, rafters or other woodwork. The intermediate party walls may be taken up to the roof covering.

Solid Brick Walls.—Even when built in Portland cement and sand (1 to 3), solid brick walls will generally be found less expensive than hollow walls containing the same amount of brickwork built in lime mortar, and they are undoubtedly stronger and more likely to last well. They require, moreover, less care in construction. On the other hand, they are neither so warm nor so damp-proof; the brickwork may, however, be rendered externally to resist weather, or for the sake of appearance in some cases. Speaking generally, then, solid walls built in Portland cement and sand (1 to 3) may be used in unexposed situations when good hard bricks can be obtained; but to ensure the walls being sufficiently damp-proof, great care must be taken that the joints are properly "*flushed up*" at every course.

Solid walls should always be used for buildings over three stories in height.

Stone Walls.—In the case of stone buildings, all walls, except to Cellars and similar places, should be lined on the inside with a 4½-in. skin of brickwork, with three courses of stretchers and one or two of headers, according to the thickness of the stone courses, bonding into the stonework. In plastered rooms the brick lining may be omitted, provided the stone can be relied upon to keep out damp.

In very exposed situations, or with stone that passes moisture readily, it may be necessary to cement the masonry externally.

Weathering and Throating.—All cornices, copings, strings, sills and other similar projections should be weathered; they should also be well throated so as to avoid discolouring the wall surface below.

Wood Plugs, &c.—The joiners' work should be fixed to concrete blocks made with breeze, or to wood plugs, 6 in. by 3 in. by 1 in., driven into the joints of the brickwork or masonry, and cut off plumb. The former are preferable. Wood bricks should not be used.

Windows.

The windows most commonly used in W.D. work are 1¾ in. or 2 in. double-hung sashes.

Casement sashes are sometimes used either for economy or appearance, and are desirable in warm climates; but they are liable to damage from weather.

Fixed steel sashes of approved pattern, with or without hopper openings, are used in Stores and other places where security is required.

Glass Space.—The amount of glass space required for a room depends on its size, proportions, situation and use. In fixing the size and position of windows it must be remembered that, apart altogether from the necessity of giving enough light to enable the occupations within to be carried on, direct sunshine and light are essential to health, cleanliness and cheerfulness, and that windows should also be arranged with a view to giving through ventilation whenever possible.

In measuring glass space, the meeting rails and sash bars, for convenience sake, may be taken as glass. For ordinary windows, therefore, the following deductions should be made from the size of the external opening in the brickwork or masonry, viz., 8 in. from the height, for the oak sill and top and bottom rails of the sashes; and 4 in. from the width, for the sash stiles.

As too many or too large windows make a room cold, by lowering the temperature of the air generally and by tending to produce cold draughts, the amount of glass space should be restricted to what is necessary for light. In ordinary rooms this may be taken as 1 ft. super. for every 100 cub. ft. of space in the room, assuming that buildings are not put closer together than twice their height from the ground floor to the eaves.

Various circumstances may render slight variations desirable. Upper floor windows, and those with no buildings opposite to them, might have rather less glass space. If buildings are too close together, or if they are built of dark stone, or red or dark-coloured brick, or if the barracks are situated in smoky towns, more glass space might be allowed. This is especially the case if the windows are covered by a verandah. The glass space at Home, however, should never fall below $\frac{1}{12}$ths of a ft. super. for every 100 cub. ft. of space, and would rarely exceed $\frac{1}{10}$th.

Shops, Kitchens, Scullories, Pantries, Wash-up Rooms, Cook Houses, Bath Rooms, Ablution Rooms, Water Closets and Lavatories it is almost impossible to make too light.

Rooms that are lofty in proportion to their depth from the window wall, rooms with windows on two sides, especially on opposite sides, rooms with white or light-coloured walls and paint, are all more easily lighted than rooms with the opposite characteristics.

With windows on one side only it would be extremely difficult to sufficiently light a very low deep room with dark walls.

In rooms where the windows are not all in the same wall, the greater part of the glass space should, when practicable, be provided in the walls which face from S.E. to S.W., except in such cases as require North light, *e.g.*, drawing offices.

In hot countries, where plenty of air is desirable with subdued light, the use of verandahs and wood louvres solves the difficulty.

As a rule windows should be carried up as close as possible to the ceiling line.

Windows— *continued.*

Glazing.—All windows should be glazed with thirds 15-oz. sheet glass, except where stated otherwise.

Where obscured glass is desirable 15 or 21 oz. ground glass may be used, or for better work ¼ in. rough cast plate.

For common skylights and glazed doors ¼in. patent rolled rough plate may be used.

Obscured glass admits only about 50 per cent. as much light as clear glass.

In exposed situations, or where rooms are over-windowed, the substitution of 42 oz. glass for thin sheet glass has sometimes been found successful in enabling a proper temperature to be maintained. When this fails double windows may have to be used.

In dark situations prism glass may be used to increase the light.

Jamb Linings, Frames, &c.—In plastered walls, jamb and soffit linings and architraves, to correspond with the doors, may be provided.

Windows not provided with jamb linings should have fillets screwed to the inside of the frame, double chamfered, or chamfered on one edge and scribed to the wall as may be necessary, and pointed in hair mortar, to cover the junction of the frame with the wall.

The sills of the window frames, including the iron tongue, should be bedded in white lead.

Sash Cords and Sash Fasteners.—For ordinary sashes, flax sash line may be used; but for very heavy sashes, and in positions where constant breakage of sash cords is likely to occur, sash chains are advisable.

In down-stair rooms, when the windows are accessible from outside and are not barred, patent sash fasteners, provided with a locking arrangement, which prevents the catch being tampered with from the outside, may be provided.

Sills, Outside.—Stone, concrete, or brick sills should project 2 in. and should be weathered and efficiently throated so as to avoid discolouring the wall surface below. They should be grooved on the upper surface, ⅜ in. deep for a 1¼ in. by ⅛ in. galvanised iron tongue fitting into a groove on the under side of the oak window sill to serve as a water bar.

Stone sills should stop at least 4½ in. from the inside face of the wall, as they often cause damp to show when they go right through it. Concrete sills should be formed in moulds and allowed to properly set before being fixed.

Sills, Inside.—Will usually be of wood, concrete, or brick.

Sills, Heights of.—The height from the floor to the top of the outside sills is chiefly governed by the two factors which mainly determine the amount of glass space, viz., the character and purpose of the room to which the windows belong. Moreover, in the case of an important structure, full consideration must also be given to the general treatment of the Elevation.

In order to obtain satisfactory results, the lowest point at which light should be admitted to a room should, as a general rule, lie between 2 ft. 9 in. and 3 ft. 6 in., within which limits the various requirements of design, *e.g.*, glass space, view, arrangement of fittings, and external appearance of the windows, can usually best be met. Deducting 6 in. for the height of bottom rail and oak sill, it will be seen that the height of the outside sill above the floor will vary, in ordinary cases, from 2 ft. 3 in. to 3 ft. 0 in.

Brick dimensions should invariably be worked to.

Skylights.—If a patent method of glazing is not adopted, it is essential that the puttying should be protected by a hard wood fillet rounded on the upper surface and fixed with brass screws to the sash bar, as otherwise the putty soon perishes from the action of the weather. It is generally necessary to guard against the dripping of moisture condensed on the under surface of skylights to rooms, by means of condensation gutters, or otherwise.

Weatherproof Windows.—In very exposed situations it is often necessary to make special provision against wet being driven in.

Window Openings.—The quoins to window openings, when likely to be damaged, should be rounded off or finished with bull-nosed bricks.

Much useful information as to details of joinery will be found in the S.M.E. "Notes on Doors and Windows."

Section III.

OUTLINE SPECIFICATIONS.

These particulars are intended for guidance as to the general style of finish considered suitable in each case. A careful consideration of the special conditions, and the most economical materials available locally, may often render modification desirable.

OFFICERS' MESS ESTABLISHMENT.

Remarks on Design, Siting, &c.

As a rule, the Single Officers' Quarters are provided in conjunction with the Mess Establishment, being so arranged that although easily accessible to the Officers, they are entirely separated.

The Officers' Mess should be sited with aspect S.E. to N.W. and overlooking the Parade or open country, with ground in front laid out as Mess Garden.

Floors and Paving.

Porch to Principal Entrances.—Marble mosaic paving, unglazed ornamental tiles, or other paving of a suitable nature, with stone steps at outer edge.

Lobby, Hall, Corridors.—Marmor-terrazzo paving, unglazed plain tiles in three colours, thin wood block or other flooring of a suitable nature.

Band Alcove.—Similar to room or passage off which it may be situated.

Mess and Ante Rooms.—Special pitch pine, 1¼-in.

Lavatory, W.C.'s and Urinals.—Marmor-terrazzo paving, or unglazed plain tiles in three colours.

Billiard Room, Mess Kitchen.—Thin wood block, 1½-in.

Mess Office, Mess Waiter's Bedroom, Waiters' Day Room, Pantry.—Ordinary deal, 1¼-in.

Mess Man's Quarters.— As for Married Soldiers' Quarters.

All other Floors.—Cement concrete.

Part of Courtyard and Yards.—Cement concrete currented to gullies or surface channels.

Ceilings.

All rooms and passages plastered, with the exception of the Plate Closet, which should be of cement concrete not less than 6 in. thick and limewhited.

Rooms and passages used by Officers to have moulded cornices of suitable girths and design, Mess and Ante Rooms may also be further enriched by panelling.

Billiard Room to be plastered to underside of rafters and collars fixed at straining beam level of queen post trusses, and with moulded and varnished wood cornice and ribs.

Kitchen as for Billiard Room, but omitting cornice and moulding to ribs. Exposed timbers to be painted.

In the case of Outbuildings with open roofs, the underside of all exposed timbers to be limewhited.

Mess Man's Quarter, as for Married Soldiers' Quarters.

Walls, Dados and Skirtings.

Mess Room, Ante Room, Billiard Room.—Plastered and painted, or papered with paper to cost 2*s* 4*d*. per piece, moulded wood skiritng and picture rail.

Lobby, Hall, Corridors, Band Alcove, Mess Office.—Plastered and painted, with painted cement dado and moulded skirting.

Officers' Lavatory, Officers' W.C.'s, Officers' Urinals.—Plastered and distempered, with painted cement dado, beaded top and bottom, or finished with glazed tiling to a height of 4 ft. 6 in.

Mess Kitchen, Pantry, Mess Waiter's Bedroom, Waiters' Day Room.—Plastered and distempered, with 6-in. plain wood skirting.

Scullery.—Plastered and limewhited, with 6-in. chamfered cement skirting.

Plate Closet.—Walls to be 14 in. thick. Plastered and distempered with 6-in. chamfered cement skirting.

All other walls.—Flat jointed and limewhited, with 6-in. chamfered cement skirting.

Porch.—Finished as external walling.

Yard Walls.—To be 7 ft. high on the inside.

Mess Man's Quarter.—As for Married Soldiers' Quarters.

Doors and Gates.

External.

Principal Entrances.—Specially designed.

Back Entrances.—2 in., panel, flush on outside, with glazed upper panels or fanlight to open inwards.

Outhouses, W.C.'s in Yards.—1 in., ledged and braced.

Yards.—2 in., framed and braced, with capping.

Internal.

Mess Room, Ante Room, Billiard Room and any other Rooms, &c., used by Officers.—2 in., panel, moulded both sides. Doors from Mess and Ante Rooms, opening into Hall, should be hung folding.

Screens in Entrance Hall and across Corridors for shutting off Mess premises from Officers' Quarters.—2 in., panel, moulded both sides, upper part glazed, with swing doors in centre, lower panels moulded both sides and upper panels glazed.

Cellars.—2 in., panel, flush on outside and fitted with approved cellar locks.

Plate Closet.—6 ft. 3 in. by 2 ft. 3 in., of $\frac{3}{16}$ in. sheet iron riveted to a $2\frac{1}{2}$ in. by $\frac{1}{2}$ in. wrought iron framing, hung on pivots to a 3 in. by $\frac{1}{2}$ in. wrought iron frame, built into the wall with four 6-in. horns and fitted with a 5-lever lock.

All other doors.—$1\frac{1}{2}$ in., panel, square both sides, but where opening off principal corridor to be moulded on outside.

Staircases.

Officers'.—Pitch pine, not less than 3 ft. 6 in. wide, 11-in. treads, $6\frac{1}{2}$-in. risers, with moulded close strings, square newels with moulded caps and pendants, turned balusters and polished hard wood handrail.

To Cellars in Basement.—Stone, 3 ft. wide, square steps, wrought-iron round or square balusters and round handrail, $10\frac{1}{2}$-in. treads and 7-in. risers.

Mess Man's Quarter.—As for Married Soldiers' Quarters.

Windows.

Principal Rooms. Top of outside sills 2 ft. 3 in. above floor level.

Billiard Room.—Lantern in roof with side windows hung on pivots. Other windows, if any, kept above eye level.

Mess Kitchen.—Lantern in roof, with side windows hung on pivots. Other windows as necessary for extra light and ventilation.

Officers' Lavatory, W.C.'s and Urinals.—Lantern in roof may be provided with glazed top and side windows hung on pivots, each W.C. to have a separate window with outside sills 4 ft. to 5 ft. above floor level.

W.C.'s in Yards, Wash-up Rooms, Outhouses.—Top of outside sills 4 ft. to 5 ft. above floor level.

Scullery and Pantry.—Top of outside sills 3 ft. 6 in. above floor level.

All other Windows.—Top of outside sills 2 ft. 9 in. above floor level where not required to range with adjacent windows at other heights.

All accessible windows and fanlights to Mess Man's and Mess Waiters' departments to be barred.
Mess, Ante and Billiard Rooms should be glazed with 2nd quality 21-oz. plate glass.
Officers' passages and Mess Office to have seconds 21-oz. sheet glass.
All other windows should be glazed with thirds 15-oz. sheet glass, or with $\frac{1}{4}$-in. rough cast plate where desirable.
Glazed doors to have $\frac{1}{4}$-in. rough cast plate.
Skylights to have $\frac{1}{4}$-in. fluted plate glass.

Barrel-way.

To Cellar, approached by trap door outside building.—3 ft. 6 in. by 4 ft. 6 in. opening, to be trimmed round with 9 in. by 6 in. oak curb, securely fixed down.

The trap door, $1\frac{1}{2}$ in. oak, ledged and braced, hung folding, skidding, sides 6 in. by 4 in. oak, with wrought-iron distance pieces, and fitted with wrought-iron hooks to fasten to eyes in oak curb above.

SINGLE OFFICERS' QUARTERS.

Remarks on Design, Siting, &c.

Quarters for Single Officers are, as a rule, provided in conjunction with the Officers' Mess Establishment. The quarters, although communicating with the Mess Premises, should be so arranged that they can be entirely shut off.

Servants' rooms should not, where practicable, open off Officers' passages.

Floors and Paving.

Entrance Lobbies, Bath Rooms, Officers' W.C.'s on Ground Floor.—Marmor-terrazzo paving or unglazed tiles in three colours, of suitable design.

Officers' Passage on Ground Floor.—Thin wood block, 1¼ in.

Officers' Rooms, Officers' Passages on Upper Floors.—Special deal, 1¼ in.

Servants' Rooms, Servants' Passages, W.C.'s on Upper Floors.—Ordinary deal, 1¼ in

Yards.—Gravelled, but a portion may be paved with cement concrete, currented to a gully.

All other Floors.—Cement concrete.

Ceilings.

All plastered with moulded cornices to Officers' Rooms and Passages.

Out-houses, W.C.'s in Yards.—Flat concrete roofs, or open roofs, with underside or exposed timbers limewhited.

Walls, Dados and Skirtings.

Entrance Lobbies, Officers' W.C.'s, Officers' Passages.—Plastered and distempered, painted cement dado, and finished with a flush bead top and bottom. Passages to have moulded cement skirtings also.

Officers' Rooms.—Papered, with moulded deal skirting. Paper to cost 1*s.* 6*d.* per piece for Sitting Rooms and 1*s.* 4*d.* for Bedrooms. Moulded wood picture rail to be provided.

Bath Rooms.—Plastered and painted, dado of glazed bricks or tiles, to a height of 5 ft.

All other Walls.—Flat jointed and limewhited, with 2-in. deal quadrant skirting or 6-in. chamfered cement skirting for wood or concrete floors respectively,

Yard Walls.—To be 7 ft. high on the inside.

Doors and Gates.

External.

Front Entrances.—Specially designed.

Back Entrances.—2-in., panelled, flush on outside. The upper panels of these doors may be glazed.

Out-houses, W.C.'s in Yards.—1-in. ledged and braced.

Yards.—2-in. framed and braced, with capping.

Internal.

Officers' Rooms, Officers' Accessories.—1¾-in., panelled, moulded both sides.

Servants' Rooms, Servants' Accessories.—1½-in., panelled, square both sides, but moulded on outside when opening off Officers' passages.

Staircases.

Officers'.—Pitch pine, 3 ft. to 3 ft. 6 in. wide, 11-in. treads, 6½-in. risers, moulded strings, square turned balusters, polished hardwood handrail, square newel with moulded caps and pendants.

Servants'.—Deal, 3 ft. wide, 9-in. treads, 7½-in. risers, beaded strings, square balusters, hardwood handrail, newel of plain design.

Windows.

Officers' Rooms.—Ground floor, top of outside sills 2 ft. 9 in. above floor level. Upper floors, top of outside sills 2 ft. 6 in. above floor level.

Servants' Rooms.—Top of outside sills 3 ft. 0 in. above floor level.

All other Windows.—Top of outside sills 2 ft. 9 in. above floor level where not required to range with adjacent windows at other heights.

Officers' Rooms and Passages.—To have seconds 21-oz. sheet glass.

Skylights.—To have ¼-in. patent fluted glass.

Glazed Doors.—To have ¼-in. rough cast plate.

MARRIED OFFICERS' QUARTERS.

Remarks on Design, Siting, &c.

Quarters for Married Officers of Class 8, and above that class, will usually be built detached; other Married Officers' Quarters semi-detached, unless site area is restricted, when they may be in terraces.

Floors and Paving.

Drawing Rooms, Dining Rooms, Studies.—Special pitch pine, 1¼ in.

Entrance Lobbies, Lavatories, W.C.'s on Ground Floor.—Marmor-terrazzo paving, or unglazed tiles in three colours.

Halls.—Thin wood block, 1¼ in.

Passages on Ground Floor, Stores, Kitchens, Pantries.—Solid wood, 1¼ in.

Officers' Rooms and Passages on upper floors.—Special deal, 1¼ in.

Sculleries, Larders, Cellars, Out-houses, Servants' W.C.'s and part of Yards.—Cement concrete.

All other Floors.—Ordinary deal, 1¼ in.

Ceilings.

Plastered in all rooms and passages.

Reception Rooms, Hall and Personal Passages on Ground Floor.—To have moulded cornices.

Dining and Drawing Rooms.—May be panelled.

Out-houses.—Flat concrete roofs, or open roofs, with underside or exposed timbers limewhited.

Walls, Dados and Skirtings.

Entrance Lobbies, Halls, Personal Staircases, Reception Rooms, Personal Bedrooms, Dressing Rooms, Bath Rooms, Lavatories, Personal W.C.'s and all other Personal Rooms.—Plastered and papered, with moulded wood skirting, and picture rail where necessary.

Servants' Halls.—Plastered and papered, with 2-in. deal quadrant skirting.
The rooms for which paper hangings are authorised may be papered at the following cost:—

—	Living or Sitting Rooms.	Bedrooms and Dressing Rooms.	Bath Rooms and W.C.'s (if papered).	Halls, Staircases and Landings (if papered).	Servants' Halls, Bedrooms and Back Passages (if papered).
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Classes 3 and 4	2 4	1 6	1 2	1 6	0 10
„ 5, 6, 7 and 8	2 0	1 4	1 0	1 4	0 10
„ 9 and 10	1 8	1 4	1 0	1 0	0 9
„ 11, 12, 13 and 14 Quarter-Master and Riding-Master	1 6	1 0	1 0	1 0	0 9

Servants' Rooms, Passages, Staircases, Kitchens and Inside W.C.'s.—Plastered and distempered, with 6-in. plain wood skirting.

Sculleries, Pantries, Stores.—Plastered and distempered, with 6-in. chamfered cement skirting.

W.C.'s in Yards, Cellars, Out-houses, Cleaning Sheds, &c.—Flat-jointed and limewhited, with 6-in. chamfered cement skirting.

Yard Walls.—To be 7 ft. high on inside.

Doors and Gates.

External.

Principal Entrances.—Specially designed

Back Entrances.—2-in. panel, flush on outside, with fanlight to open inwards, if desirable.

Out-houses, W.C.'s in Yards, &c.—1-in. ledged and braced door.

Yard.—2-in. framed and braced, with capping.

Internal.

Reception Rooms.—2-in panel, moulded both sides.

Personal Bedrooms.—1¼-in. panel, moulded both sides.

All other Rooms, &c.—1¼-in panel, square both sides, with the exception of doors opening on to personal passages, which should be moulded on outside.

Wine and Beer Cellars.—2-in. flush panel, and fitted with approved cellar locks.

Staircases.

Principal.—Pitch pine, 3 ft. to 4 ft. wide, with 11-in. treads, 6½-in. risers, moulded strings, square turned balusters, polished hardwood handrail, square newel with moulded caps and pendants.

Servants.—Deal, 2 ft. 9 in. wide, 9-in. treads, 7½-in. risers, chamfered strings, newels of plain design, square balusters, polished hardwood handrail.

Windows.

Reception Rooms.—Top of outside sills 2 ft. 3 in. above floor level.

Bedrooms, generally.—Top of outside sills 2 ft. 6 in. above floor level.

Lavatories, W.C.'s, Bath Rooms, Pantries, Out-houses.—Top of outside sills 4 ft. above floor level.

Sculleries.—Top of outside sills 3 ft. 6 in. above floor level.

Pantries.—Barred.

Skylights.—To have ¼-in. patent fluted plate glass.

Glazed Doors.—To have ¼-in. rough cast plate.

WARRANT OFFICERS' QUARTERS.

Remarks on Design, Siting, &c.

As a rule, Warrant Officers' Quarters will be built semi-detached or in terraces. They will usually be sited in or near the Married Soldiers' Lines and in the case of the Regimental Serjeant-Major's Quarter, conveniently accessible from the Guard House Block.

Floors and Paving.

Floors Generally—Ordinary deal, 1¼ in.

Scullery and part of Yard.—Cement concrete.

Ceilings.

Plastered, a 9-in moulded cornice to Living Room.

Walls, Dados, Skirtings, &c.

Living Room, Bedrooms.—Plastered and papered with paper 1*s.* 2*d.* per piece for Living Room and 9*d.* per piece for Bedrooms. Living Room with 8-in. single-faced and moulded wood skirting, Bedrooms with 6-in. plain wood skirting.

Kitchen.—Plastered and distempered, with 6-in. plain wood skirting.

Scullery.—Plastered and limewhited, with 6-in. chamfered cement skirting.

Coal Store.—Flat-jointed and limewhited.

Passages, Staircase and W.C.—Plastered and distempered, with painted cement dado.

Yard.—Wall 7 ft. high on inside.

Doors and Gates.

Front Entrance.—1¾-in. panel, flush on outside, fanlight to open inwards.

All Internal Doors.—1½-in. panel, square both sides.

Yard.—2-in. framed and braced, with capping.

Back Entrance.—1¾-in. panel, flush on outside.

Outbuildings and External W.C. (*if any*).—1 in., ledged and braced.

Staircase.

Deal, 2 ft. 9 in. wide, treads 9 in., risers 7½ in., square balusters two to each step, hard wood handrail, and plain newels.

Windows.

Top of outside sills, 2 ft. 9 in. above floor level, except in W.C,, where it should be 4 ft. to 5 ft., and in Scullery, 3 ft. 6 in.

MARRIED SOLDIERS' QUARTERS.

Remarks on Design, Siting, &c.

As a rule, will be grouped together in rows, each quarter being a separate self-contained cottage.

Where site area and frontage are restricted, the design will be specially considered; the most suitable type being one in which the quarters are arranged in blocks of flats, each flat opening either off verandahs common to all, or landings arranged on central staircases.

As regards siting, the quarters should be built apart from other barrack buildings, but convenience of access to the Serjeants' Mess, Canteen and Recreation Establishment should be considered.

A small Yard, with iron railings and gates, is provided to each quarter.

In Barracks for more than one battalion, regiment, &c., it may be convenient to group the Married Soldiers' Quarters together to facilitate the allotment of the quarters.

Floors and Paving.

Floors Generally.—Ordinary deal, 1¼ in.

Scullery, W.C., and portion of Yard.—Cement concrete.

Ceilings.

Plastered.

Walls and Skirtings.

Living and Bedrooms.—Plastered and distempered, with 6-in. plain wood skirting.

Scullery.—Plastered and limewhited, with 6-in. chamfered cement skirting.

W.C.—Flat-jointed and limewhited, with 6-in. chamfered cement skirting.

Doors and Gates.

Front Entrance.—1¾-in. panel, flush on outside, with fanlight to open inwards.

All internal Doors.—1⅜-in. panel, square both sides.

Back Entrance.—1¾-in. panel, flush on outside.

W.C.—1-in. ledged and braced.

Staircase.

Deal, 2 ft. 6 in. wide, treads 8 in., risers 8 in., square balusters, two to each step, hardwood handrail, and plain newels.

Where quarters are in flats, or open off common verandahs, stone or iron staircases should be provided for common use.

Verandahs.

When provided, the railings should be 3 ft. 9 in. high, balusters not more than 4½ in. apart in the clear, and no horizontal rails other than at top and bottom should be provided. The bottom rail should be fixed not more than 3 in. above floor level.

Windows.

Top of outside sills 2 ft. 9 in. above floor level, except in Scullery, where it should be 3 ft. 6 in. high.

LAUNDRIES.

Remarks on Design, Siting, &c.

Should be sited conveniently near the Married Soldiers' Quarters. When the general water supply is hard, an underground rain-water tank should be provided.

Laundries should be provided with a drying ground, part of which should be turfed and the remainder gravelled.

Floors.

Wash Houses.—Cement concrete 6 in. thick, laid in parallel grooves 8 in. apart, currented to surface channels and discharging through walls.

Boiler House.—Cement concrete 6 in. thick and currented as necessary.

Drying Closet.—Cement concrete 6 in. thick, arranged 6 in. above the level of the Wash House floor and currented to discharge on to the latter, with metal runners for drying horses.

Ironing Room.—Solid wood, 1½ in.

Ceilings.

None; the boarding and exposed timbers throughout should be limewhited.

Walls and Skirtings.

All walls to be flat jointed and limewhited. The Wash House and Boiler House to have chamfered cement skirting and the Ironing Room a 2-in. quadrant skirting.

Doors and Gates.

Entrance Doors.—2-in. framed and braced, hung folding, with fanlights to open.

Internal Doors.—1½-in. panel, square both sides.

Windows.

Steel casements, with upper parts to open at centre. Laundries should be well lighted. The top of outside sills should be at least 4 ft. above floor level.

Ventilation.

Should be thorough, and means provided for carrying off steam, &c., by ridge ventilation over Wash House and Ironing Room.

BARRACK BLOCKS FOR SINGLE N.C.O.'S AND MEN, INCLUDING DINING ROOMS, COOK HOUSES, BATH HOUSES, &c.

Remarks on Design, Siting, &c.

The Barrack Blocks and their accessory buildings should be conveniently sited near the Parade Ground.

Barrack Rooms should not be built over Stables unless the site area is so restricted as to render such a course unavoidable, in which case special sanction must be obtained.

Barrack Rooms should be designed with windows in opposite walls.

Beds should be placed with their heads against the external walls, with not more than one bed in any corner, and not more than two between any two windows.

Floors and Paving.

Barrack Rooms.—Special deal, 1¼ in., with a portion of teak about 6 ft. by 4 ft. at entrance and in front of fire-place.

Serjeants' Rooms, Stores.—Ordinary deal, 1½ in.

Dining Rooms.—Solid wood, 1½-in. teak.

Passages and Lobbies giving access from Barrack Rooms to Night Urinals and W.C.'s.—Solid wood, 1½-in. teak.

All other Floors and Passages.—Cement concrete.

Verandahs, if any, to be 6 in. below floor level of rooms, and currented to shed water.

Ablution Rooms, Cook and Bath Houses.—To be currented to surface channels discharging directly through the wall.

Cook House.—To be of stone at entrance and around cooking apparatus.

Covered ways.—To be currented outwards, and finished with a stone curb.

Night Urinals.—To be raised 4 in. above the floor of the annexe and finished at edge by stone step.

Ceilings.

Barrack Rooms, Serjeants' Rooms, Dining Rooms, Stores, Wash-up Rooms, Passages.—Plastered.

Ablution Annexes.—Plastered on upper floors and on ground floors formed of concrete floor over, and limewhited.

Heating Chamber and Coal Store in Basement.—Cement concrete, formed by floor above, and limewashed.

Cook House.—Open roof with exposed timbers painted.

All others to be open roofs with exposed timbers limewhited.

Walls, Partitions and Skirtings.

All walls to be flat-jointed and limewhited.

Bath House and Ablution Annexe Partitions.—Concrete slabs 7 ft. high, finished with cement and limewhited or faced with glass tiles to a height of 5 ft., walls to be finished to match up to a height of 5 ft. and flat-jointed and limewhited above.

6-in. chamfered cement skirtings to be provided where concrete floors, with the exception of basement, and 2-in. deal quadrant skirting where wood floors.

Barrack and Serjeants' Rooms.—To have a dado in continuation of the pin rails below soldiers' locker and shelf, formed by fixing an iron band 1½ in. wide and ⅛ in. thick, screwed to wood plugs, carried round room, including reveals, and japanned or painted black.

The dado should be coloured with copperas and lime.

Dining Rooms.—To have a similar dado to barrack rooms.

Cook House.—A few courses of glazed bricks or tiles should be placed above the benches and dressers.

Doors and Gates.

External.

2-in. framed and braced.

Fanlights to be provided where necessary.

Internal.

1¾-in. panel, square both sides, with 1-in. panels.

Staircases.

May be of stone, concrete or of teak on iron framing, 4 ft. 6 in. wide, 10 in. treads, 7-in. risers, fitted with non-slipping treads.

Windows.

Barrack Rooms.—Should be designed so as to be easily adaptable for cubicles, each requiring a separate window. Top of outside sills 3 ft. above floor level.

Ablution Rooms.—Where over ablution benches, top of outside sills should be 4 ft. above floor level.

Bath House.—Top of outside sills 4 ft. above floor level and with lower panes of obscured glass

Windows— *continued.*

Cook House.—Flat hard wood sills, 1 ft. 6 in. wide and 2 ft. 6 in. above floor level, as service windows. The remaining windows should have the top of outside sills 4 ft. above floor level and the upper third of sash hinged at bottom to fall inwards.

Wash-up Rooms.—Top of outside sills 3 ft. 6 in. above floor level.

All other Windows.—Top of outside sills 3 ft. above floor level.

Night Urinals and W.C.'s—Top of outside sills 4 ft. to 5 ft. above floor level.

Boiler House in Basement.—Windows to be barred or arranged to open off a small area protected by iron grating.

Ventilation.

Barrack Rooms.—Outlets, in addition to the flue from fireplace, should be provided having not less than 1 square in. clear cross sectional area to 60 cubic feet of room space.
Inlets should together have the same cross sectional area, and should be fixed 8 ft. to 10 ft. above floor level

Cook Houses.—Should be provided with a large lantern, having pivot hung side sashes. A specially ventilated hood over the cooking apparatus may be provided where necessary.

Bath Rooms.—Windows should be hung on pivots.

Wash-up Rooms.—Should be ventilated by perforated bricks.

WATER CLOSETS (OR LATRINES) AND URINALS.

Remarks on Design, Siting, &c.

Should be conveniently sited, so as to be readily accessible, but detached from the Barrack Blocks; separate W.C.'s and Urinals being arranged for night use only, near the Barrack Rooms, but disconnected by ventilating lobbies.

Compartments should be provided for the use of Serjeants, attached to the block for Rank and File, but with separate entrances.

Entrances should be screened.

Provision should be made for a small Pioneer and Lime Store.

Concrete platforms to take the ash bins serving the Barrack Rooms, Cook Houses, &c., may conveniently be placed at the ends of these blocks.

Floors and Paving.

Closets.—Cement concrete, currented to doorways. The floor of each compartment to be raised at least 5 in. above the floor outside.

Urinals.—Cement concrete, currented to surface channels.

Lime Store.—Cement concrete, currented to doorway.

Walls, Partitions and Skirtings.

All walls to be flat-jointed, limewhited, and finished with 6 in. chamfered cement skirtings.

Partitions between latrine compartments to be of 1-in. slate, 3 in. clear of floor, and carried to a height of 6 ft. 3 in. above floor.

Bull-nosed bricks should be used at all projecting angles. Re-entering angles to be avoided as much as possible.

Doors.

Closets.—Self-opening, ¾-in. ledged and braced, with 6 in. bolt on inside, and no latch.

There should be a clear 6 in. between top of door and frame over, and 12 in. between bottom of door and floor.

Store.—Self-closing, 1-in. ledged and braced, with oak stock, deadshot lock, and no latch.

Roofs.

Closets.—Slate slabs carried on steel bearers.

Urinals.—To be sheltered by a hood formed of slate slabs carried on steel cantilever brackets.

Store.—Flat, of cement concrete.

The Lime Store, Closet and Urinal for Serjeants may be grouped together and the roof constructed of cement concrete to carry water supply tank over.

Ventilation

Closets.—A continuous course of air bricks should be arranged in rear of wall of each compartment at a level of 6 ft. 3 in. above floor.

SERJEANTS' MESS.

Remarks on Design, Siting, &c.

The building should be sited among the Recreation Accessories, but not too close to the Canteen.
A small verandah or hood, over an external service hatch should be arranged to form the Jug Department.

Floors and Paving.

Entrance Lobby.—Marmor-terrazzo paving, or unglazed tiles in three colours.

Hall, Passages, Billiard Room, and Liquor Store.—Solid wood, 1½ in.

Dining Room, Reading and Writing Room, Cook's Room, Store.—Ordinary deal 1½ in.

Part of Yard.—Cement concrete currented to gully.

All other Floors and Paving.—Cement concrete.

Ceilings.

Entrance Lobby, Hall, Billiard Room, Dining Room, Reading and Writing Room.—Plastered, with cornices of suitable girths.

Kitchen.—Open roof with exposed timbers painted.

All other Ceilings.—Plastered.

Walls, Dados and Skirtings.

Entrance Lobby, Hall and Passage.—Plastered and distempered with painted cement dado.

Billiard Room, Dining Room, Reading and Writing Rooms.—Plastered and distempered, or papered with paper to cost 1*s.* 6*d.* per piece, moulded wood skirting and picture rail.

Kitchen.—Plastered and distempered, with chamfered cement skirting.

Scullery, Lavatory Anneze.—Plastered and limewhited, with chamfered cement skirting.

Knife House, Beer Cellar.—Flat-jointed and limewhited, with chamfered cement skirting.

Liquor Store, Mess Store.—Flat-jointed and limewhited, with a 6-in. plain wood skirting.

Coal Store, W.C. in Yard.—Flat-jointed and limewhited.

Cook's Room.—Flat-jointed and limewhited, with a painted dado and 6-in. plain wood skirting.

Doors and Gates.

External.

Principal Entrance.—2-in. deal, panelled, flush on outside, with fanlight hung to open inwards

Back Entrance.—1¾ in. panel door, flush on outside, with fanlight hung to open inwards.

Out-houses.—1-in. ledged and braced.

Yard.—2-in. framed and braced, with capping.

Internal.

Screen between Hall and Entrance Lobby.—2-in. deal panel, moulded both sides, upper part glazed, swing doors in centre panelled, lower panels moulded both sides and upper panels glazed.

Principal Rooms.—2-in. panel, moulded both sides.

Liquor Store.—To form serving door, 2-in. deal panel, bottom panels moulded outside, square framed inside, upper part made to slide or lift up, and fitted with a strongly fixed 1½-in. hard wood counter.

All other internal Doors.—1½-in. panel, square both sides, but where opening off principal passages moulded on outside.

Windows.

Principal Rooms.—Top of outside sills 2 ft. 3 in. above floor level.

Larder, Mess Store, Cook's Room, Kitchen.—Top of outside sills 3 ft. above floor level.

Scullery, Knife-house.—Top of outside sills 3 ft. 6 in. above floor level.

Lavatory.—Top of outside sill 4 ft. 6 in. above floor level.

W.C.'s.—Top of outside sills 5 ft. above floor level.

Window in Liquor Store forming Jug Department.—To have 1½-in. hard wood shelf with 2-in. brackets arranged outside, fitted with 1½-in. deal bead flush and square shutters, furnished with strong fastenings.

Ventilation.

Dining, Reading and Writing Room, Billiard Room.—Outlets should be arranged in the ceilings, connected with shafts and terminated by suitable means of extract.

Kitchen.—A lantern in roof, with glazed top, side windows hung on pivots.
The above is in addition to the ordinary means of ventilation.

Urinals.—Open to the air.

Staircases.

If the building is not on one floor, a staircase of deal 3 ft. to 3 ft. 6 in. wide will be provided. Treads 10 in., risers 7 in., polished hard wood handrail and square balusters, newels of plain design.

Step Ladder to Beer Cellar in Basement (approached by a trap door, 1¼-in. deal, ledged and braced in floor of the Liquor Store).—To have 7 in. by 1½ in. deal sides and 7½ in. by 1½ in. deal treads, housed into sides, sides to be bolted to floor joists above. A handrail, fixed to wall at side, to be provided.

Barrel-way.

To Cellar, approached by a trap door outside building.—3 ft. 6 in. by 4 ft. 6 in. opening, to be trimmed round with 9 in. by 6 in. oak curb, securely fixed down. The trap door, 1½-in. oak, ledged and braced, hung folding. Skidding, sides 6 in. by 4 in. oak, with iron distance pieces, and fitted with wrought iron hooks to fasten to eyes in oak curb above.

RECREATION ESTABLISHMENT.

Remarks on Design, Siting, &c.

Should be sited adjacent to the Barrack Blocks and with convenient access to the Grocery Shop from the Married Soldiers' Lines.

The manager will, as a rule, reside on the premises, and covered communication from the quarter to Coffee Bar and Grocery Shop (behind Counter) should be arranged.

The stage should be arranged across end of lecture room, raised 3 ft. above floor level, finished in a suitable manner, and separated by a fire-proof curtain wherever necessary.

Floors and Paving.

Entrance Lobby.—Unglazed tiles in three colours.

Rooms arranged on Ground Floor; also Dressing Rooms, Passages and W.C.'s if in Basement.—Solid wood. 1½ in.

Rooms arranged on First Floor and Stage.—Ordinary deal, 1½ in.

Manager's Quarter.—As for Married Soldiers' Quarters.

All other Floors.—Cement concrete.

Ceilings.

Principal Rooms.—Should be plastered and finished with cornices of suitable girth.

Kitchen.—Open roof with exposed timbers painted.

Out-houses.—Should have flat concrete roofs or open roofs, with underside or exposed timbers limewhited.

Manager's Quarter.—As for Married Soldiers' Quarters.

Walls, Dados and Skirtings

Principal Rooms.—Plastered and distempered with a painted cement dado and moulded skirting.

Entrance Lobby, Staircase, and Landings.—Plastered and distempered with painted cement dado.

Dressing Rooms, Passages.—Plastered and distempered, with a 2-in. deal quadrant skirting.

Kitchen, Scullery, Grocery Shop, Store.—Plastered and limewhited, with chamfered cement skirting.

Boiler-house, Out-houses.—Flat-jointed and limewhited.

Yard Wall.—7 ft. high above paving inside.

Manager's Quarter.—As for Married Soldiers' Quarters.

Doors and Gates.

External.

Principal Entrances.—2-in. deal, panel, flush on outside, fitted with fanlight, to open inwards.

All other Entrances.—1¾-in. deal panel, flush on outside, fitted with fanlight to open inwards.

Gates to Yard.—2-in. framed and braced.

Coal Stores, Out-houses.—1-in. ledged and braced.

All Internal Doors.—1¾-in. deal panel with 1-in. panels, square both sides.

Supper Room and Grocery Shop.—To have keys differing from those of other locks.

Manager's Quarter.—As for Married Soldiers' Quarters.

Staircases.

Principal.—Deal, 3 ft. 3 in. wide, 10-in. treads, with moulded nosings, 7-in. risers, moulded strings, newels of suitable design, 1¼-in. square balusters, and oak handrail.

To Basement.—Stone, square, 10½-in. treads, 7-in. risers, with iron or hardwood newels, and handrail, and iron balusters.

To Stage.—Deal, 2 ft. 6 in. wide, 10-in. treads, 7-in. risers, and chamfered wall strings.

Manager's Quarter.—As for Married Soldiers' Quarters.

Windows.

In all Rooms, Staircase, Landings.—Top of outside sills 3 ft. above floor level.

Scullery.—Top of outside sills 3 ft. 6 in. above floor level.

W.C.'s.—Top of outside sills 5 ft. above floor level.

Where necessary, the windows should be barred.

Rooms, Passages, &c.—In basement should be lighted by windows opening off small areas covered with iron gratings or otherwise protected.

Manager's Quarter.—As for Married Soldiers' Quarters.

Ventilation.

Billiard Room, Kitchen.—In addition to the ordinary ventilation, a top light, with sides pivoted on centres to open, should be provided.

CANTEEN.

Remarks on Design, Siting, &c.

The Canteen should, as a building, be entirely separate from the Recreation Establishment, and sited so as to be convenient both to the Single Men's Blocks and to the Married Soldiers' Quarters, but it should not be too near the Serjeants' Mess.

Floors and Paving.

Soldiers' Room, Corporals' Room, Bar, Office, Jug Department.—Solid wood, 1¼ in.

Managers' Quarter.—As for Married Soldiers' Quarters.
All other floors of cement concrete.

Ceilings.

Soldiers' Room, Corporals' Room, Bar, Office, Jug Department.—Plastered or match-boarded to under-side of rafters and collars.

Entrances.—Plastered.

Out-houses.—Flat concrete roofs or open roofs, with underside or exposed timbers limewhited.

Cellar.—Concrete flooring over limewhited.

Manager's Quarter.—As for Married Soldiers' Quarters.

Walls and Skirtings.

Soldiers' Room, Corporals' Room, Bar, Jug Department.—Flat-jointed and limewhited, with 2-in. deal quadrant skirting.

Office—Plastered and distempered, with 2-in. deal quadrant skirting.

Entrances, Beer Cellar.—Flat-jointed and limewhited, with 6-in. cement chamfered skirting.

Out-houses.—Flat-jointed and limewhited.

Manager's Quarter.—As for Married Soldiers' Quarters.

Doors and Gates.

External.

Front Entrance to Canteen.—2-in. panel, flush on outside, with fanlight to open inwards.

Other Entrances.—1¾-in. panel, flush on outside, with fanlight to open inwards.

Out-house and Urinals.—1-in. ledged and braced.

Internal.

Soldiers' Room.—1¾-in deal panel with 1-in. panels, square both sides, hung folding to swing.

Other Doors.—1⅜-in. panel, square both sides.
All doors to Bar should have lever locks with differing keys. Doors to Cellars to have approved cellar locks.

Manager's Quarter.—As for Married Soldiers' Quarters.

Staircases.

Step ladder to Beer Cellar approached by a trap door, 1½-in. deal, ledged and braced in floor of Bar; to have 7 in. by 1½ in. deal sides and 7½ in. by 1¼ in. deal treads, housed into sides; sides to be bolted to floor joists above.
A handrail fixed to wall at side should be provided.

Manager's Quarter.—As for Married Soldiers' Quarters.

Windows.

Soldiers' Room, Corporals' Room.—Upper part hinged to fall inwards. Top of outside sills 3 ft. above floor level.

All other Windows.— The top of outside sills to be 3 ft. above floor leve .

Manager's Quarter.—As for Married Soldiers' Quarters.

Ventilation.

Soldiers' Room, Corporals' Room.—Outlets should be arranged in the ceilings connected with shafts, and terminated by suitable means of extract.

Urinals.—Should be exposed to the air, and the ventilating lobbies provided with air bricks or gratings in addition to windows, so as to admit of through ventilation.

Barrel-way.

To Cellar, 3 ft. 6 in. by 4 ft. 6 in., approached by a trap door, 1½-in. oak, ledged and braced, from outside of building. Sides to skidding to be 6 in. by 4 in. oak, with ¾-in. bolts, to serve as distance pieces; the ends of sides fitted with wrought iron hooks, to fasten to eyes screwed into oak curb at top.

CHAFF-CUTTING MACHINE SHED.

Remarks on Design, Siting, &c.	Should be sited near the Forage Barn. A simple shed of corrugated iron will suffice. Provision should be made in the walls and floor of the shed for the support and attachment of the gear.
Floor.	Cement concrete.

DRILL AND GYMNASTIC HALLS.

Remarks on Design, Siting, &c.

Drill and Gymnastic Halls should open off the Parade. They should be situated in the vicinity of the Recreation Accessories and, as far as practicable, in a central position with regard to the Barrack Blocks. Space for extension should always be reserved.

Floors and Paving.

Entrance Lobby.—Cement concrete or stone.

Instructors' Room and Lobby to Hall.—Solid wood, 1¼ in.

Gallery.—Ordinary deal, 1¼ in.

Hall.—Special deal, 1¼ in., on joists spaced 18 ins. centre to centre. Provision should be made as necessary for attachment of portable gymnastic apparatus.

(*Note.—The use of this floor for drill in boots is prohibited; all work is to be done in shoes.*)

All other Floors.—Cement concrete.

Ceilings.

Hall.—Matchboarded and painted or stained and varnished, with small wood moulding at junction with wall

Entrance Lobby, Lobby to Hall, Instructors' Room, and Store.—Matchboarded and painted.

Boiler House, Coal Store, and Lobby to Urinals.—Concrete floor, or roof, over limewhited.

Walls, Dados, and Skirtings.

Hall.—Flat-jointed and limewhited, with dado of brown glazed bricks 4 ft. 6 in. high and having 4 in. by 1¼ in. wood capping and 2 in. hardwood quadrant skirting.

Instructors' Room.—Plastered and distempered, with painted cement dado.

Entrance Lobby, Staircase, Lobby to Hall, and Gallery.—Flat-jointed and limewhited, with dado of brown glazed bricks, and 2 in. quadrant deal skirting in the case of wood floors.

All other Walls.—Flat-jointed and lime whited, with 6 in. chamfered cement skirting to Store and Lobby to Urinals.

Doors.

External.

Entrance Lobby and Staircase.—2 in., panel, flush on outside and square inside. Hung folding.

Hall.—(For drill purposes only.) As last, but not less than 6 ft. 3 in. wide and 8 ft. high.

Boiler House and Lobby to Urinals.—2 in., framed and braced, the former hung folding.

Coal Store.—1 in., ledged and braced.

Internal.

All internal doors 1¼ in., panel, square both sides. The entrance door to Hall and the door between Entrance Lobby and inner Lobby should each be hung folding and to swing, with upper panels framed for glazing.

Stairs.

To Gallery.—Of deal, 10 in. treads, 7 in. risers, square wrought iron balusters, plain cast iron newels, and hardwood rounded handrail.

To Boiler House.—Of stone, with wrought iron balusters, handrail, and railing.

Windows.

Hall.—Windows, with steel sashes, should be provided in side and end walls. Side windows should be continuous in each bay, with tops of stone sills 12 ft. above floor, and the central light of each bay hung on centres or otherwise arranged to open. End windows should be 8 ft. above floor of Hall and 4 ft. above floor of Gallery respectively, the upper portion in each case being hung on centres or hinged at the bottom to open.

All other Windows.—Tops of stone sills not less than 3 ft. above floor. The windows of Store and Boiler House should be barred or fitted with steel sashes having part to open.

Ventilation.

Hall.—Inlets should be provided in connection with the warming arrangements. Three lengths of ridge ventilator, each having means of closing, should be provided as outlets.

Roof.

Hall.—Open roof, with steel trusses carried on brick piers showing on outside only.

Balustrade.

Gallery.—Along front, 3 ft. 6 in. high, hardwood rounded handrail and square newels, and balusters of deal.

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DRILL SHED (OPEN).

arks on gn, Siting, Should be sited facing the Parade Ground and conveniently near the Men's Quarters.

ors and ing. Gravelled or macadam surface laid to a depth of 3 in. on a hard brick filling 4 in. thick, with a fall of 1 in. in 10 ft. to a surface gutter along the front.

lls and tings. Interior flat-jointed and limewhited, the back and ends only to be enclosed with walls.

of. Open, with exposed timbers limewhited. Steel trusses carried on cast iron columns on front side.

FIVES COURT.

Remarks on Design, Siting, &c.

Should be constructed on what is known as the "Marlborough" type, having a back playing wall 14 ft. 6 in. high, side walls 13 ft. 3 in. next playing wall and sloping to 6 ft. at rear of Court.

The Court should, as a general rule, be sited to run North and South, with the playing wall at the North end.

Floors.

Cement concrete, 9 in. thick, laid to a fall of 1 in. in 5 ft. to the rear, on hard filling, and faced to a perfectly true and smooth surface with Portland cement and sand, half and half, in two coats, the sand for the top coating being formed of block or foundry sand with a little lamp black added.

Walls.

14 in. solid, with piers 18 in. by 18 in., showing on the outside only at the four angles and at the centre of each wall. The internal faces should be finished as in the case of the floor.

FIRE ENGINE HOUSE.

Remarks on Design, Siting, &c.	Should be sited near the Guard House Block or form part of it
Floor.	Cement concrete currented at 1 in 100 to Entrance.
Walls.	Flat-jointed and limewhited.
Doors.	7 ft. wide, 2¼-in. deal, framed and braced, hung folding to open outwards or made sliding.
Windows.	Top of outside sills 5 ft. 6 in. above floor level. To be barred.
Ventilation.	Louvred openings in gables, or air-bricks or iron gratings in the side walls about 8 ft. above floor level.
Roof.	Open, with exposed timbers limewhited.

GUARD HOUSE.

Remarks on Design, Siting, &c.

Should be sited at or close to the Principal Entrance, and overlooking the Parade and Barracks generally. It is usually provided in conjunction with the Regimental Offices and forming one building.

The Small-Arm Ammunition Store, when provided, should be in this block and under the observation of the sentry.

Fire Engine House, if not forming part of the Guard House, should be sited near it.

A lean-to roof, carried on brackets on nearest convenient wall, should be provided for the ladders required for use in the Barracks.

The Prisoners Room and Passage to Cells should open off the Guard Room.

Windows of Cells should, when possible, give into Yard.

Floors and Paving.

Guard Room.—Teak wood block 1¼ in.

Prisoners' Room and Cells.—Deal wood block 1½ in., rendered non-absorbent.

Verandah.—Cement concrete laid to fall from the building and finished at outer edge with a stone curb.

Passages.—Cement concrete or stone. Lobbies set aside for ablution purposes to be currented to channels under ablution benches, to discharge directly through wall.

Small-Arm Ammunition Store.—Cement concrete or stone.

W.C. s.—Cement concrete currented towards door.

Urinals.—Cement concrete currented to surface channels

Yards.—Cement concrete currented to central gully.

Night Urinal.—From Prisoners Room to edge of Urinal to be 1¼-in. slate laid to fall and to discharge over a gully. The bottom of Urinal itself to be of glazed stoneware, constructed to drain into gully and formed in cement concrete.

Ceilings.

Guard Room.—Plastered.

Prisoners Room.—Plastered on approved metal lathing.

Cells, Passages and S.A.A. Store.—Concrete 6 in. thick, and limewhited. When the ceiling forms the roof it should be 12 in. thick.

Fire Engine House, W.C.'s.—Open roofs, exposed timbers limewhited.

Verandah.—Open roof, exposed timbers painted.

Urinals.—Open to the air.

Night Urinals.—Limewhited

Walls and Skirtings.

External.

To Cells, 18-in. solid, all others 14 in. solid.

Internal.

Between Guard and Prisoners' Rooms, 9 in. solid, all others 14 in. solid.

Guard Room, Prisoners' Room, Cells, S.A.A. Store.—Flat-jointed and limewhited, with 2-in. quadrant skirting. Cell walls to have a painted dado 4 ft. high.

Night Urinal.—Back of glazed stoneware, built up in cement concrete to a height of 4 feet above that left open for ventilation purposes, and protected by round iron bars to another 3 ft., securely fixed at bottom and curved half round at top. Jamb linings at entrance, flat-jointed and limewhited with 6-in. cement skirting and bullnosed angles.

Passages.—Flat-jointed and limewhited, with 6-in. chamfered cement skirting. Rendered in cement under ablution bench.

W.C.'s.—Flat-jointed and limewhited, with 6-in. chamfered cement skirting.

Yard.—12 ft. high on inside.

Doors nd Gates.

External.

Guard Room.—2-in. framed and braced.

S.A.A. Store.—2-in. solid panel, flush both sides, fitted with approved lever lock

Yard.—2-in. framed and braced with fanlight over.

Internal.

Prisoners' Room and Night Urinal.—2-in. solid panel, flush both sides, covered with sheet iron on side of Prisoners' Room.

Doors and Gates—*contd.*

Cells.—2-in. solid panel, flush both sides, fitted with inspection plate and glass, to lock on outside only. Half the number to be covered with sheet iron on Cell side.

Door from Guard Room to Cell Passage.—2-in. solid panel, flush both sides. To lock on both sides and provided with barred fanlight, if necessary.

W.C.'s in Yard.—1¼-in. ledged and braced with 3-in. clear at top and bottom.

Windows.

Guard Room.—Top of outside sills 3 ft. above floor level. Windows over verandah to have steel sashes of approved pattern, with central portion to open.

Prisoners' Room, Cells, Cell Passages, S.A.A. Store.—Steel sashes of approved pattern, clear fluted plate glass $\frac{3}{16}$ in., four flutes to the inch. Prisoners' Room and Cell windows, top of outside sills 7 ft. above floor level.

Ventilation.

Guard Room.—As for Barrack Rooms.

Prisoners' Room.—Inlets and outlets to give 20 square in. per man. About half the inlet ventilation should be provided by "hit and miss" gratings under the bed worked from outside; the other half by L.V.'s 8 ft. above floor, two or three being over the bed.

A fresh air duct, opening behind the coil, should be provided when warmed by hot water, and should give 100 square in. clear sectional area and have a "hit and miss" grating at outer end. This can be used in cold weather in place of the inlets under bed and in hot weather as a supplementary inlet.

All inlets are to be in direct communication with the outer air, each opening being protected by a horizontal round iron bar, 1¼ in. in diameter, built into wall.

An outlet flue, 200 square in. in clear sectional area, protected at foot by iron bar or an iron grating, and terminated by a cowl, should also be provided.

Night Urinal.—In addition to being exposed to the air an opening at either side at the bottom, 9 in. wide, 1 ft. 9 in. high, protected by round iron bars, should also be provided.

Cells.—The foul air should be extracted from each Cell through a 9 in. by 6 in. (clear) flue, which should have a cast iron grating at its foot and lead into an iron trunk terminated by a cowl.

Fresh cold air should be admitted separately to each Cell through a traversed duct in the external wall, the opening to the Cell being in the sill of the window. The duct should be finished outside with perforated bricks, or an iron grating, and on the inside with a valve under the control of the prisoner.

Warming.

Prisoners' Room, Cells and Passages.—By hot water from the Guard Room range, a "cut-off" should be provided to each Cell when possible, and for Prisoners' Room and Passages.

The flow and return pipes should run along the external wall of the Cell and be enclosed in a wooden casing having therein a "hit and miss" grating, lettered "Warm," with a net opening of 54 square in. for the admission of warm fresh air.

Fresh cold air should be admitted to the inside of the casing by a 9-in. by 6-in. traversed air duct, with an external grating well above the ground giving 54 square in. net area of air passage, and with a sheet iron shutter at inner end giving a maximum opening of 54 square in., capable of being reduced by the prisoner to a minimum of 18 in. The warm air inlet grating should be at the end of the casing furthest from the bed, the cold air inlet being at the opposite end.

To prevent signalling the portion of the pipes opposite the "hit and miss" grating should be covered with a layer of hair felt, bound on by copper wire, and to prevent sound passing from one Cell to another through the pipe channel in the division wall, a sand box should be provided at the end of the wooden casing next division wall between Cells.

~~GUN AND WAGON~~ Vehicle SHEDS.

Remarks on Design, Siting, &c.

The Sheds should be conveniently near the Stables and Parade Ground. Space should be reserved for future extension, whenever practicable. When the Gun Sheds cannot be arranged to open on to the Parade, 150 ft. open space should be reserved in front of the Sheds.

For the purpose of washing vehicles a concrete paved washing place should be provided in front of the building.

Where Batteries of a Brigade are quartered together, it is usual to group all the Battery Gun Sheds and Ammunition Wagon Sheds in the same range, separation being obtained by means of movable iron partitions.

Partitions of light iron framing and corrugated iron reaching from floor to roof, and so fixed as to be easily removed, should separate the Mobilization vehicles from the Peace vehicles.

Rings should be fixed in the paving of the Sheds for ~~tethering~~ picketing horses for mobilization purposes. They should be in lines across the building, arranged for horses head to head. Rows of head rings not less than 6 ft. apart, head and heel rings not less than 14 ft. apart. One row of heel rings does for two lines of horses. Rings at least 4 ft. 6 in. apart in each row, and rings in each row at least 2 ft. from edge of curbs. The rings should be 2½ in. inside diameter of ⅝-in. metal, securely attached to bolt or other fixing bedded in concrete, and should be countersunk so that all parts are below floor level.

Floors and Paving.

The interior to be of cement concrete of 5 in. average thickness, finished with granite siftings, laid to a fall of 1 in 80 from back wall of Shed to the front of curbs, and finished with a shallow pitcher surface channel currented to a gully. Wheel tracks 6 ft. wide should be provided.

Washing-Place. — Cement concrete, about 6 in. thick, finished with granite siftings, laid with a fall to a trapped gully at centre, surrounded by a flush curb formed of 7-in. by 5-in. granite pitchers.

Ceilings.

The rough boarding on the underside of roof to be limewhited.

Walls and Skirtings.

Flat-jointed and limewhited.

The cross and back walls, for protection from damage, should have curbs edged with 5-in. by 3-in. by ½-in. angle steel hurters, with 3-in. by 6-in. by 3-in. steel lugs 3 in. wide, riveted or bolted to hurter at 6 ft. intervals, and filled in with concrete to a depth of 12 in. and 1 ft. wide at cross walls, 2 ft. 3 in. wide at back walls.

The end of the doors when open and the stanchions and brick piers at entrance to bays to be protected by cast iron curbs with sloping sides, 4 in. above floor, sunk 4 in. below and filled in with concrete 8 in. thick.

A cupboard for blank cartridges, 2 ft. wide by 2 ft. 1½-in. deep and 6-ft. high, to contain three metal-lined cases of blank cartridges should be constructed in the angle formed by the junction of back wall with end wall of Gun Shed (Peace portion). It should be of wood, with a 2-ft. door hung to open outwards against back wall, and the whole should rest on the concrete curb, which should be carried to a distance of 2-ft. 3-in. in front of the cupboard.

Doors and Gates.

2½-in. framed and braced, hung folding to open outwards, the lower edge of the door being strengthened on the inside by an angle iron and the inner corners being cut away to clear the curb which will be fitted to the same centre as that on which the door revolves.

Gates for bays for Peace vehicles and Machine Gun Sheds and one bay of Mobilization vehicles should lock on the outside and be provided with bottom bolts. All other doors and gates should fasten with top and bottom bolts on the inside.

Roofs.

To be open, with steel trusses between the bays, supported by brick wall at the back and stanchions in front.

OFFICES.

Remarks on Design, Siting, &c.

When it can be conveniently arranged, Regimental Offices should be in the same block as the Guard House, and so arranged that all rooms may open off a verandah running the full length of the building.

A Telephone Room will be provided in connection with the Offices when a Military Administrative Telephone or Telegraph System exists.

Offices for a Battery of R.F.A., R.H.A., or a Company of R.G.A. should adjoin the Battery or Company Store, and, together with the Shops, be grouped together in one block, and provided with a verandah.

The Quartermaster's and Clerks' Offices are situated in the Regimental Shops and Stores Block and those for the Barrack Warden in the A.S.C. Barrack Expense Stores.

Floors and Paving.

Offices.—Solid wood, 1½ in., on Ground Floor. Ordinary deal, 1½ in., on Upper Floors, with sound pugging.

Verandahs.—Cement concrete, currented from building, finished at outer edge with stone curb and surface gutter drained to a gully.

W.C.'s and Lavatories.—Cement concrete.

Yards.—Gravelled, or of cement concrete currented to gullies.

Ceilings.

All plastered. Officers' Rooms to be finished with a moulded cornice of suitable girth.

Walls and Skirtings.

All plastered. Officers Rooms to be papered with paper costing 1*s.* per piece, finished with moulded wood skirting. Other rooms plastered and distempered and finished with a painted cement dado 4 ft. high and 2-in. deal quadrant skirting.

W.C.'s and Verandahs.—To be finished with 6-in. chamfered cement skirting.

Yards.—Walls to be 7 ft. high on the inside.

Doors and Gates.

External.

Offices, &c.—2-in. deal panel, bead flush on outside and moulded on inside. Fanlights to be provided, where necessary, to open inwards.

W.C.'s.—¾-in. ledged and braced.

Internal.

1¾-in. deal, panel, moulded both sides in Officers' Rooms, and in other cases to be square framed. Where necessary upper panels should be glazed.

Windows.

Top of outside sills 2 ft. 9 in. above floor level.

Roofs.

Verandahs.—Slated, but may be glazed throughout, or in part, for efficient lighting of rooms. Exposed timbers and underside of boarding to be painted.

Outside W.C.'s.—Flat concrete, with soffit limewhited.

RIDING SCHOOL.

Remarks on Design, Siting, &c.

The Riding School and Open Manèges should be sited together.

Floors and Paving.

School.—Formed on a bed of broken brick, 6 in. thick, and to consist of 12 in. of faggots, laid in two 6-in. layers crossing each other, and a top layer of tan and sawdust (3 to 1) 12 in. thick. To prevent the faggots working up the end of those in the upper layers should be bound and securely fastened down by means of galvanised iron wire, wooden battens, or other convenient materials.

Gallery.—Ordinary deal, 1½ in.

All other Floors.—Cement concrete.

Ceilings.

School, Gallery.—Open roof. Exposed timbers limewhited.

Entrance Lobbies, Stores.—Matchboarded.

Walls and Skirtings.

School.—Flat-jointed, and limewhited, protected at base to a height of 6 ft. 6 in. by horizontal guard boarding laid to a batter, and projecting 1 ft. 6 in. in front of wall at floor line. The guard boarding should be formed of 1½-in. wrought, match and V-jointed battens, secured by wrought clasp nails to rough framing and finished at top by a 2-in. rounded capping, grooved for boarding. The battens to a height of about 1 ft. 3 in. above floor line should be of elm, and a line indicating the level of the top of tan should be painted around the walls 12 in. above the level of top of faggots.

The portions in front of entrance doors and door to Lobby between Stores under Gallery should be prepared as framed and braced gates, wrought both sides, and of the same width as the doors behind, hung folding, or single hung as the case may be, to framed steel angles fixed at head and bedded in concrete below floor level. These gates should range with guard boarding when closed, and fall back on the latter when open.

Jumping Bar Supports.—To afford support for inner end of movable jumping bar a wrought iron plate should be fixed flush with guard boarding, in the centre of each side of the School. The plate should be 5 ft. long, 3 in. wide and ½ in. thick, with holes in it ¾ in. diameter, and 4 in. apart, the lowest being 6 in. above floor line.

Markers should be painted on wall, at a height of 7 ft. 6 in. above floor level to centre of markers.

Centre markers, at centres of end and side walls, black ground, 12 in. diameter with white Greek cross.

Quarter markers outside walls, 15 yards from each end wall, black ground, diamond shaped, and 12 in. high, with white centre 6 in. diameter.

Gallery.—Flat-jointed and limewhited, with 2-in. deal quadrant skirting.

All other Walls.—Flat-jointed and limewhited, with 6-in. chamfered cement skirting.

Doors and Gates

School.—2½-in. framed and braced, made to slide.
There should be two entrances, each 8 ft. 6 in. wide, and situated at end opposite to gallery

All other Doors.—2-in. framed and braced. External doors being fitted with fanlights.

Staircases.

To Gallery.—Wood, 3 ft. wide, 10-in. treads, 7-in. risers, square balusters, newels of simple design, hardwood handrail.

Windows.

School.—In gable ends and side walls. Top of outside sills 11 ft. 9 in. above floor level.
Centre light in each bay should be hung on pivots, to open.

Stores.—Fitted with steel sashes, top of outside sills 3 ft. 6 in. above floor level.

Ventilation.

School.—At eaves and ridge; also wood louvred openings in gable ends.

Balustrade.

Along front of Gallery.—3 ft. 6 in. high to top of upper rail, lower portion filled in.

Roof.

Open, with steel trusses.

OPEN MANÈGE

Remarks on Design, Siting, &c.

Open Manèges should be situated as near as practicable to the Riding School.

They should be arranged in parallel lines, and not less than 15 yards apart, so that all sides may be drilled under one supervision.

Floors and Paving.

Should have a pervious upper stratum and effective subsoil drainage.

To ensure the above, the floor should be formed of not less than 9 in. of light sandy gravel and shingle mixed (all free from loam), laid on a foundation of coarse screened gravel, broken brick, or stone, or other similar hard material, 12 in. deep.

In cases where the nature of the ground prevents rapid percolation, the subsoil under and surrounding the Manège should be drained by means of agricultural drain pipes, discharging into a proper outlet.

The upper surface of the floor to be flat and raised about 12 in. above the surrounding ground.

The ground outside entrance is to be sloped up to floor of Manège as necessary

Walls and Skirtings.

To be formed of banks of turf, with upper surface not more than 3 ft. above surrounding ground with entrance 9 ft. wide at one end.

FORGES AND SHOEING SHEDS.

Remarks on Design, Siting, &c.

Should form a detached block, situated near the Troop Stables and as far as practicable from the Forage Barn.

Shoeing Sheds should communicate direct with the Forges. Entrance doors and windows should be in the front wall, the rear one being reserved for tethering rings. A paved approach should be provided in front of entrance, sloped up to threshold of doorway.

Floors and Paving.

Forges.—Hard brick paving laid on edge on cement concrete.

Shoeing Sheds.—Thick wood block, 6 in.

Paved Approach.—Cement Concrete, currented to surface channels at front and sides.

Ceilings.

Open roofs, with exposed timbers limewhited.

Walls and Skirtings.

Flat-jointed and limewhited.

Doors and Gates.

Shoeing Sheds.—2½-in. framed and braced, hung folding, each leaf to be in two heights, the lower half 3 ft. 6 in. high and protected on top edge along the length, by a wrought iron plate.

Forges.—2-in. framed and braced.

Fanlights may be provided where necessary.

Windows.

Forges.—Top of outside sills 2 ft. 6 in. above floor level. To be barred.

Shoeing Sheds.—Top of outside sills 2 ft. 6 in. above floor level. As much glass space as possible to be provided.

Ventilation.

Forges.—At ridge of roof.

Shoeing Sheds.—A lantern about three-quarters of the length of shed, with fixed louvres, should be provided.

SHOPS.

Remarks on Design, Siting, &c.

Regimental Shops are generally grouped together in one building with the Regimental Stores and conveniently sited as regards the Barracks; but in a suitably retired position.

Armourers' Drying Closet and *Armourers' Store* should open off Armourers' Shop.

Plumbers', Painters' and Glaziers' Shop should communicate with Carpenters' Shop.

Floors and Paving.

Shops generally.—Where not otherwise described should have solid wood floors 1½-in. deal on ground floors and ordinary deal 1½-in. on upper floors.

Armourers' Shop, Store and Drying Closet.—Thick wood block, 6-in.

Saddlers' and Wheelers' Shop.—Thick wood block, 4 in.

Plumbers', Painters' and Glaziers' Shop.—Cement concrete.

Ceilings.

Saddletreemakers' Shop, Shoemakers' Shop, Tailors' Shop, Saddlers' Shop, Saddlers' and Wheelers' Shop.—Plastered.

Armourers' Drying Closet.—Cement concrete 6 in. thick.

Remaining to have open roofs, with exposed timbers limewhited.

Walls and Skirtings.

Shops generally.—Flat-jointed and limewhited with 2-in. deal quadrant skirting to wood floors and 6-in. chamfered cement skirting to concrete floors, no skirtings to thick wood block floors.

Doors and Gates.

External.

Armourers' Shop.—2-in. framed and braced, hung in two heights, the lower half to be 3 ft. 6 in. high.

Carpenters' Shop, Wheelers' Shop.—2-in. framed and braced, hung folding.

Remaining.—2-in. framed and braced.

Internal.

Armourers' Drying Closets.—3 ft. by 7 ft. of $\frac{3}{16}$-in. sheet iron riveted to wrought iron framing, 2½ in. by ⅜ in., hung on pivots to 3 in. by ½ in. wrought iron frame, securely built into wall and fitted with iron rim lock and bar handle complete.

Remaining.—2-in. framed and braced.
Fanlights may be provided where necessary.

Windows.

Tailors', Saddlers' and Shoemakers' Shops especially should be well lighted.

Shops generally.—Top of outside sills 3 ft. above floor level and fitted with steel sashes, with part to open, or where this will not give a sufficiently free current of air, wooden casement sashes with iron bars to the windows may be given.

Ventilation.

Shops generally.—Those having open roofs will be ventilated at the ridge, and those having ceilings will, in addition to the ordinary ventilation, have an outlet in the ridge with a flue, terminated by a cowl.

STORES.

Remarks on Design, Siting, &c.

Regimental Stores are generally grouped together in one building with the Regimental Shops and centrally sited as regards the Barracks.

For convenience in administration and superintendence it is desirable to keep the Clothing Store and General Store together with the Quartermaster's Office.

General Stores and Clothing Stores in two-storied buildings should be arranged on the Ground Floor.

Bread and Meat Stores should be sited for convenience of receipt and issue of rations.

Oil Stores, required where Barracks are lighted by oil, should be at some distance from other buildings, well ventilated, and arranged in a half-sunken area so as to prevent the oil spreading in case of fire.

Coal Yards should be centrally situated so as to minimise fatigue duties, but in suitably retired situations.

Militia and Reservists' Stores should have passage ways at least 4 ft. 6 in. wide between the racks to facilitate packing, issuing, cleaning, &c. There should be a door at each end with a through gangway 6 ft. wide.

A.S.C. Barrack Expense Stores.—The Barrack Warden's Office and the Stores should be in the same block, and arranged so as to open on to a small Yard common to both and provided with gates for entry of wagons, &c. Internal communication should be provided between the Stores and the Office.

Mobilization Equipment Storehouses should be situated near to or adjoining the Wagon Sheds. Where Batteries of a Brigade are quartered together it is usual to group all the Mobilization Stores, including those for the Ammunition Column, in one block, separation being affected by means of movable iron partitions.

Floors and Paving.

Barrack Warden's Office, Quartermaster's Office, Bread Store, Bedding Store, Mattress Repairing Room, Armouries, Storehouses, Militia Clothing Store, Mobilization Equipment Storehouse, Arms and Accoutrement Store, Clothing Store, Battery or Company Store.—Solid wood, 1¼ in.

All other Floors.—Cement concrete.

Ceilings.

Bread Store, Meat Store, Clothing Store, Battery or Company Store, Bedding Store, Mattress Repairing Room, Quartermaster's and Barrack Warden's Offices.—Plastered.

Mobilization Equipment Storehouses.—Matchboarded.

Remaining to have open roofs with exposed timbers limewhited.

Walls and Skirtings.

Bread Store, Clothing Store, Battery or Company Store, Bedding Store, Mattress Repairing Room, Mobilization Equipment Storehouses.—Flat-jointed and limewhited, with a 2-in. deal quadrant skirting.

General Store, Utensil Store, Unserviceable Store, Foul Bedding Store, W.C.'s.—Flat-jointed and limewhited, with 6-in. chamfered cement skirting.

Meat Store.—Lined with white glazed bricks or tiles.

Quartermaster's Office.—Plastered and papered with paper to cost 1*s.* per piece, and with moulded wood skirting.

Quartermaster's, Clerks' and Barrack Warden's Office.—Plastered and distempered, with painted cement dado 4 ft. high and 2-in. deal quadrant skirting.

Coal Yards.—External walls 10 ft. high and crowned with bottling in cement.

These walls must be calculated to withstand the thrust of coal stacked against them to the greatest height to which it might be stacked.

Yards.—7 ft. high on inside.

Verandahs.—Wall to be finished with 6-in. cement skirting.

External.

Doors and Gates.

Unserviceable Store, Meat Store, General Store, Clothing Store, Battery or Company Store, Bedding Store, Utensil Store, Armouries, Militia and Reservists' Store.—2-in. framed and braced, and hung folding.

Coal Yards.—3-in. framed and braced, finished with capping, weathered, and with iron spikes on top. Gunmetal rollers should be fixed under gates to run on wrought-iron racers let into paving. To open outwards or to slide; a wicket door should be provided if there is not a separate entrance to Shed.

A.S.C. Barrack Expense Stores.—Gates as for Coal Yard, but with a wicket door.

Mobilization Equipment Stores.—2-in. framed and braced. Special locks to be provided with differing keys.

Remaining.—2-in. framed and braced.

Where necessary, guard stones should be provided at entrances to protect from injury by vehicular traffic.

Internal.

Doors and Gatess—*contd.*

Quartermaster's Office.—1¾-in. panel, moulded on inside.

Quartermaster's, Clerks and Barrack Warden's Offices.—1½-in. panel, square both sides.

Remaining.—2-in. framed and braced.

Staircases.

To Verandahs on First Floor.—Strings and joists of steel with supporting brackets and columns of cast iron, teak treads 10 in. by 2 in., with metal protectors of approved make let in, teak risers 7 in. by 1 in., railings of wrought iron with cast-iron standards.

Windows.

The size of the panes in the steel sashes should be small enough to give protection against theft.

Bread Store.—Fitted with steel sashes, of approved pattern, with part to open. Top of outside sills 5 ft. above floor level.

Quartermaster's, Clerks', and Barrack Warden's Offices.—Top of outside sills 2 ft. 9 in. above floor level. To be barred.

Meat Store and Foul Bedding Store.—Unglazed casement sashes, hung folding, filled in with louvres, fixed on splay and covered inside with stout perforated zinc. Top of outside sills 5 ft. above floor level.

Mobilization Equipment Stores.—Fitted with steel sashes of approved pattern, to open inwards, with steel hopper cage of approved pattern. If of wood, guard bars should be provided to all windows. Top of outside sills to be not more than 3 ft. 3 in. above floor level.

Remaining Windows.—Top of outside sills 3 ft. above floor level and fitted with steel sashes of approved pattern, with part to open.

Ventilation.

Meat Store.—In addition to the louvred windows there should be a dormer in roof also fitted with louvres and protected with stout perforated zinc.

Bread Store.—Inlet and outlet ventilators should be placed near the floor line and ceiling respectively, the inside being protected by ¼-in. mesh wire netting.
The upper panes of windows may also be filled in with wire netting instead of being glazed.

Foul Bedding Store.—The ventilation must be thorough and provided by means of air-bricks about 4 ft. apart in all external walls, and 6 in. above floor level, in addition to the louvred windows.

Roofs.

Coal Yard.—Over coke and wood shed should be formed of iron framing and covered with corrugated iron sheeting.

Mobilization Equipment Stores.—Open roofs, with steel trusses.

Verandahs

Verandahs.—Slated and carried on outside by cast-iron columns. Part glazed if necessary.

Ground Floor Verandahs.—Roof columns should rest on stone bases about 6 in. above the ground.

First Floor Verandahs.—Where necessary the railings should be in the form of gates so as to allow of goods being hoisted and lowered by a crane fixed above. The railings should be 3 ft. 6 in. in height.

STABLES.

Remarks on Design, Siting, &c.

Barrack Rooms should not be built over Stables, unless the site area is so restricted as to render such a course unavoidable, in which case special sanction must be obtained.

Commanding Officer's Stables may be arranged in connection with the quarters, or, where this is not convenient, they may be in the same block as the Officers' Stables.

Officers' Stables should be in a separate building to other Stables.

Troop Stables should be sited conveniently near the Barrack Blocks and Gun and Wagon Sheds.

The area between parallel blocks of Troop Stables should be paved throughout, to form, for all practica purposes, a partly-closed Yard, each Stable having its own Litter Sheds, Dung Pits, Horse Troughs, &c., separate and distinct from those of other blocks.

A concrete slope will be formed under mangers, to prevent horses striking their heads against the mangers.

One stall in each Troop Stable should be arranged for crib-biters, and should be situated between brick partition walls, with fittings and concrete slope omitted.

Harness Rooms in Artillery Stables and *Troop Stores* in Cavalry Stables should be centrally situated in the Stable.

Expense Corn and Forage Stores, to contain two days' supply, should be provided in Troop Stables, near the centre of the Stable.

Dung Pits should *not* be constructed against the walls of Stables.

Litter Sheds are generally placed against the front walls of Stables, to a depth of 9 ft., except for Infirmary Stables, where they should be placed on boundary walls on opposite side of Yard to Stables.

Horse Troughs should be conveniently placed near the Stables, and should be so arranged as not to interfere with traffic, or be likely to cause injury to runaway horses.

Infirmary Stables should be designed and sited so as to admit of future extension.

Loose Boxes should face South, *i.e.*, having the doors on the South side. Hoods projecting 3 ft. and supported on brackets should be fixed over the doors to keep off sun and wet when the upper half of the door is fastened back. Each box should have two windows, one in front wall the other in the manger wall for ordinary "Sick" and "Isolation" Boxes, but both in manger wall in the case of "Sling" Boxes.

Concrete Slopes should be omitted in all loose boxes, except Infirmary "Sling" Boxes.

Stalls in Infirmary Stables should be arranged in a series of compartments, each containing two or three stalls divided by brick walls.

Isolation Boxes should form a separate building within the Infirmary Stable Yard, and be sited distant from the other blocks by at least its height from the floor to eaves, but preferably by twice that distance.

Floors and Paving.

Internal Paving.—To be of blue Staffordshire paving bricks, laid diagonally to a 3-in. central channe l in each stall, falling to a 7-in. collecting channel running the full length of the Stable, and discharging into a gully 12 ft. at least outside the Stable wall. The passages to be laid square and drained to the same channel.

External Paving.—To be of cement concrete finished with granite siftings, grooved diagonally and sloping away from the Stable to cement concrete surface channels, situated at a distance of 12 ft. at least from the Stable wall, and discharging into a gully trap, specially constructed to keep straw, &c., out of the drains.

Stable Yards and Washing Places for Carriages should be currented to trapped gullies arranged centrally.

Dung Pits.—Portland cement, 4 in. thick, raised above the level of ground outside, and currented to a surface channel, which should discharge through the wall over a gully trap outside pit. The opening in the wall to be protected by a grating.

Litter Sheds.—Cement 4 in. thick, ungrooved, and sloped 1 in 24 to the open front.

Against Horse Troughs.—On the sides used for watering there should be pitcher or other approved paving 10 ft. wide, currented to gully trap in a cement concrete platform, so placed as not to be a source of danger.

Saddle Rooms, Harness Rooms, Troop Stable Stores, Pharmacy and Office.—Solid wood, 1¼ in

Rooms and Stores in Stable Blocks.—To be raised 7 in. above the level of Stable floor.

Forage Stores in Lofts.—Ordinary deal, 1¼ in.

Forage Stores on Ground Floor.—Cement concrete.

Coach Houses.—Cement concrete.

Ceilings.

Stables.—Plastered to underside of rafters.

Coach Houses, Forage Stores, Troop Stores, Harness Rooms, Pharmacy and Office, Infirmary Loose Boxes.—Plastered except where a loft is over, then matchboarding should be used, and a trapdoor provided for giving access to loft with a fixed step ladder or step irons.

Walls and Skirtings.

Stables.—Flat-jointed and limewhited, with 6-in. chamfered cement skirting, except where under mangers, which should have special concrete slopes in cement. Walls to Stables should always be solid.

Coach Houses, Forage Stores, Infirmary, Boiler House.—Flat-jointed and limewhited, with 6 in. chamfered cement skirting.

Pharmacy and Office.—Plastered and distempered, with painted cement dado.

Troop Stable Stores.—Flat-jointed and limewhited, with 2-in. deal quadrant skirting.

Saddle Rooms, Harness Rooms.—Lined to a height of 7 ft. with ⅞-in. matchboarding, finished on top with deal rail and at bottom with a wood skirting 7 in. high, above the lining to be flat-jointed and limewhited.

Dung Pits.—Built round three sides only, 2 ft. 9 in. high of cement concrete, or brick or stone built and rendered on inside in cement. The ends of the wing walls to have rounded angles, and be protected by guard stones.

Litter Sheds.—Cemented on the inside to a height of 4 ft.

Doors and Gates.

Loose Boxes.—2-in. deal, framed and hung in two heights to open outwards. The upper and lower parts outside to be filled in with vertical battens, the inside of the upper part to be braced, the lower part to be filled in with battens laid diagonally. The lower part to be 4 ft. 3 in. to top from floor line.
Fanlight, hung to fall inwards, should be provided to each door.

Stables, generally.—2¼-in. deal framed and braced, filled in with battens, hung in two heights and to open outwards. The lower part to be 3 ft. 6 in. to top from floor line, with upper edge bound with ⅛-in. strap iron.
Fanlight, hung to fall inwards, should be provided to each door.

Coach Houses, Forage Stores in Officers' Stables.—2½-in. deal, framed and braced, filled in with battens, hung folding to open outwards, or made to slide when the design permits.

All other External and Internal Doors.—2-in. framed and braced.

External doors of Stables should be bound at the bottom with sheet iron to render them rat-proof.
When the design permits, large doors should be made to slide in two leaves.

Windows.

Stables.—All Stable windows should be made to open by being hinged at the bottom, and falling inwards; they should be fitted with safety chains or cradles, in addition to the opening apparatus, in order to guard against any chance of the windows falling upon the horses.
The cheeks of the hoppers need not be glazed but may be filled in with zinc or perforated iron.
For each horse there should be 9 ft. super. of glass space, measured between the stiles and top and bottom rails of sashes.
In Troop Stables windows, containing not less than 4½ ft. super. of glass space per horse, should be placed over the stalls, and raised at least 8 ft. above the floor.
Stables with open roofs may have continuous fixed skylights, glazed with rough rolled glass, running along the centre portion of the roof on one side only, namely, the side least exposed to the sun; and also windows at the ends of the Stables over the doors, so as to make up the 9 ft. of glass space per horse.
In Stables with only one row of stalls, the skylight may be dispensed with; but windows, to make up for it, must be placed in the wall in the rear of the stalls, with tops of outside sills not less than 5 ft. above floor.
In Stables with two rows of stalls and rooms above, the windows over the stalls should be larger, so that, with the windows and fanlights over the doors, they may give the required glass space.
In Officers' Stables, which generally have only one row of stalls, one window over every two stalls should be provided, the 9 ft. super. of glass space per horse being made up by windows at the ends and in the rear walls, with tops of outside sills 5 ft. above the floor or by skylights.

Saddle Rooms, Harness Rooms, Troop Stable Stores, Forage Stores.—Barred.

Infirmary Loose Boxes.—Two windows in each box, one in front wall and the other in manger wall for ordinary "Sick" and "Isolation" Boxes. In the case of "Sling" Boxes, which have two doors in the front wall, both windows will be in the manger wall.

Ventilation.

Stables.—Roofs should be provided with continuous ridge ventilation along the central half of its length, and should admit of being closed on either side, but not on both sides at once.
Lanterns with fixed louvres may be provided instead, if preferred.
Fresh air inlets should be provided along the eaves, giving about 32 sq. in. of clear opening per stall.
Fresh air inlets, which are protected by gratings inside and out, should have at least one of the gratings hinged, and with the hinges on the upper edge so that the gratings will remain closed, even if left unfastened.
Traversed air ducts, of 54 sq. in. net area, and fixed between stalls, should be provided in the proportion of one duct to every two stalls. The external opening of the duct should be 9 in. higher than the internal one, and both should be fitted with gratings. The ducts supply air at a height of about 15 in. above floor line.
In Stables with only one row of stalls the rear wall should have a 3-in. continuous air brick course, 12 in. above floor line. When rooms are built over Stables, foul air shafts must be carried up above the roof; and to increase the draught, they should either be in connection with smoke flues or provided at the top with exhaust cowls of approved pattern. The shafts should have a sectional area of at least 18 sq. in. per horse and should extract from near the middle of the length of the stable when practicable.

Infirmary Stables, Officers' Stables.—Ridge ventilation, air brick at eaves level in front and manger walls and fresh air inlets, both under mangers and 12 in. above floor level in the front walls.

FORAGE BARN AND GRANARY

Remarks on Design, Siting, &c.

Forage Barns should be sited and designed to admit of future extension.

They should be conveniently situated to Troop Stables and road of approach, but at as great a distance as practicable from Forges, Armourers' Shops and Children's Playgrounds.

As little space as possible should be left between door and threshold.

Where it is necessary for forage wagons to enter the building, the entrance doors should be of suitable height and width, and arrangements made for the wagons to pass through door on the other side of the building.

Granaries should be attached to Forage Barns.

Floors and Paving.

Forage Barn and Granary.—Cement concrete. The passage way for wagons across the Barn between entrance doors to be formed of pitcher paving 4 ft. 6 in. wide, bounded by granite wheel tracks 2 ft. 6 in. wide, and sloped from middle of Barn towards doors.

Entrances should also be of cement concrete.

Ceilings.

Granary.—Galvanised sheet iron fixed to rafters, with wire netting under ridge ventilator to keep out rats and mice.

Forage Barn.—Open roof, exposed timbers limewhited.

Walls and Skirtings.

Flat-jointed and limewhited. Piers to support roof trusses to show on outside only.

Doors and Gates.

Forage Barn, Front Entrance.—3-in. framed and braced. To open outwards, hung folding, and to have a wicket door.

Back Entrance.—As for Front Entrance, but omitting wicket.

Granary.—2-in. framed and braced, hung folding. Bottom of door should be bound with sheet iron to render it rat-proof.

Windows.

Forage Barn.—Fitted with steel sashes. Situated over back entrance door and in gable wall. Top of outside sill 12 ft. 9 in. above floor level.

Granary.—Fitted with steel sash and situated over entrance door. Top of outside sill 12 ft. 9 in. above floor level.

Ventilation.

Forage Barn.—At ridge and in external walls close under eaves. The ridge ventilator should run the full length of the Barn and be glazed on top over the transverse passage way for wagons.

The wall ventilators should be 18 in. by 9 in., and the ducts should be traversed with inside openings at least 1 ft. higher than the outside, provided with hinged gratings at each end.

Granary.—At ridge, with top part glazed, and in external walls under eaves, similar to Forage Barn, but made mouse-proof throughout.

SCHOOLS.

Remarks on Design, Siting &c.

In designing Schools provision should be made for future extension.

An Adults' School, while being conveniently located with regard to the troops attending, should also be sited near the Married Soldiers' Quarters, as it serves children above the age of seven years, and should be so disposed that the windows of the School and Class Rooms have the proper aspect.

An Infants' School should be near the Married Soldiers' Quarters, and sited so that the windows of the Schoolrooms and Babies Rooms have the proper aspect.

All Schoolrooms should be lighted from two sides, and the amount of glass space should be not less than one-fifth the floor area; the best position for the windows is that which gives a left-hand light to the scholars; where left light is impossible, right light is the next best. No windows should be facing the scholars, except small ones high up for the sake of ventilation.

In rooms 14 ft. high, any space beyond 24 ft. from the window wall is insufficiently lighted.

In small rooms where it is possible to provide the regulation amount of glass space (to the floor area) in one wall only, at least one extra window should be provided in one of the other walls for ventilation purposes.

The best aspect for windows for lighting purposes is from N.W. to N.E.; and from N.E. to S.E. is better than a Westerly or Southerly aspect.

When special Elder Girls' Schools are established in Adults' Schools some modifications in design and fittings (desks) are required.

Playgrounds should be enclosed by a 4-ft. unclimbable iron fencing, without gates.

Playsheds and Playgrounds in large Schools may be conveniently divided into two parts, one for girls the other for boys.

Water Closets and Urinals for use of pupils should be arranged with the Playshed; those for boys being entirely separate from the girls and at opposite ends of the Playsheds.

The back rows of seats and desks should be raised 6 in. above the row in front by means of platforms. Seats and desks should be arranged in groups.

Staircases to upper floors should be wide, well planned and arranged so as not only to afford easy means of access, but also to effect an immediate and easy escape in case of fire.

Quarters for Schoolmasters and Schoolmistresses should not directly communicate with the Schools, and should be as for Warrant Officers' Quarters.

Floors and Paving.

Rooms, &c., on Ground Floor.—Solid wood, 1⅛ in.

Rooms, &c., on First Floor.—Ordinary deal, 1½ in., made sound proof.

Platforms for Seats.—Ordinary deal, 1½ in., raised in steps of 6 in. above the floor in front.

Playshed.—Should be currented to the Playground level and formed of cement concrete, finished with stone curb.

Playgrounds.—Tar-paved.

All remaining Floors.—Cement concrete.

Ceilings.

Plastered, except in Cleaning Rooms and Coal Stores, which will have exposed timbers limewhited.

Walls, Dados and Skirtings.

Class Rooms, Internal W.C.'s, Lavatories.—Plastered, with painted cement dado, which in the case of Class Rooms, will be carried up to the level of the under side of window sills. The walls above the dado to be treated with limewash tinted with green copperas.

In each Class Room the wall facing the seats and desks should be covered with a dull green-coloured paper, well pasted to plaster and covered with a smooth unglazed paint.

Class Rooms.—To be fitted with rails for hanging maps, pictures, &c., at heights of 6 ft. and 9 ft. above floor level.

Needlework Stores, Book Stores, Teachers' Rooms.—Plastered and distempered, with 2-in. deal quadrant skirting.

W.C.'s in Playground.—Lined with brown glazed bricks.

Remaining.—Flat-jointed and limewhited, with 6-in. chamfered cement skirting, except to Coal Stores.

Doors and Gates.

External.

Entrances.—2-in. panel, bead flush on the outside, hung folding, to open outwards, and fitted with fanlight to open, and hooks to fasten back the doors.

Pupils' Closets.—⅞-in. ledged and braced. A clear 6 in. should be left between the top of door and frame over; also 12 in. between bottom and floor for ventilation purposes. These doors should be bolted with dead shot to be locked from the outside.

Cleaning Rooms and Coal Stores.—1 in. ledged and braced.

Internal.

From Corridors to Class Rooms.—1¾-in. panel, square both sides, hung folding and opening into Corridor, with hooks to fasten them back.

Between Class Rooms.—1¾-in. panel, lower panel square both sides, with upper panels glazed, and hung sliding.

Needlework Stores, Book Stores, Teachers' Rooms, Internal Lavatories and W.C.'s.—1⅛-in. panel, square both sides.

Staircases.

To Upper Floors.—Stone, or concrete, fitted with approved patent treads, 5 ft. wide, treads 10 in., risers 7 in., 1 in. square, wrought-iron balusters, cast-iron newels, 2-in. oak handrail fixed at a height of 3 ft. to top, above level of treads; space above handrail to be protected by a guard screen fixed to balusters and covered with galvanised wrought-iron wire netting.

To Basement.—Stone, or concrete, with wrought iron handrail properly secured to side wall. Treads 8 in., risers 8 in.

Windows.

Class Rooms.—All window heads should be kept as close under the ceiling as possible, and top of outside sills to be 5 ft. above floor level or platform level. The top part of each sash should be hung at bottom to fall inwards, and provided with glazed hopper cheeks. The bottom panes should be made obscure.

Cloak Rooms, Needlework Stores, Book Stores, Teachers' Rooms.—Top of outside sills 3 ft. above floor level.

Lavatories and Internal W.C.'s.—Top of outside sills 4 ft. to 5 ft. above floor level, and fitted with obscured glass, when situated on the ground floor.

Basement.—Where necessary an opening off a small area, covered with an iron grating or in some other way protected, should be provided.

Remaining Windows.—Top of outside sills 3 ft. above floor level.

Ventilation.

Class Rooms.—Where warmed by a hot water system, ample inlet and outlet ventilation should be provided, the inlets being led, as far as possible, through the pipes.

In other cases the fresh air inlets should give a clear cross sectional area of 1 sq. in. to every 60 cub. ft. of room space.

The foul air outlets should equal in total area the inlets.

On the upper floors, ceiling outlets, connected with shafts and terminated by cowls, should be arranged.

Roofs.

Class Rooms.—Collar beam, ceiled to under side of rafters and collars, and strengthened by light iron trusses.

Playsheds.—A light iron one, supported by iron columns on the side facing the School, and by a brick wall on the other sides.

Heating.

By a hot water system in Schools of 144 seats and over. In addition, the Babies' Rooms should have an open fireplace. In all other cases by means of grates and stoves of approved pattern.

Screens.

Shutting off Staircases from Corridors.—2-in. panel, lower panels square both sides, upper panels glazed, and fitted with swing doors of a similar construction.